Multi-team system dynamics in outsourced information system development projects

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Research into team dynamics in cross organizational development teams

Walter van den Berg

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Research into team dynamics in cross organizational development teams

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ter verkrijging van de graad van doctor

aan Tilburg University

op gezag van de rector magnificus,

prof.dr. Ph. Eijlander,

in het openbaar te verdedigen ten overstaan van een

door het college voor promoties aangewezen commissie

in de aula van de Universiteit

op maandag 26 januari 2015 om 16.15 uur

door

Walter van den Berg

geboren op 22 januari 1965 te Amsterdam

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Abstract (Dutch)

Tijdens het schrijven van dit abstract in juni 2014 is (alweer ...) een breed onderzoek gaande naar falende grote ICT projecten in de overheid. Want het gaat nogal eens fout. Dat geldt overigens niet alleen bij projecten in de publieke sector; ook de commerciële sector kent de nodige falende projecten. Er is al veel onderzoek gedaan naar ICT projecten, naar outsourcing van ICT werkzaamheden, ICT governance en naar samenwerkingsverbanden tussen organisaties. Er is ook veel onderzoek gedaan naar teams, naar individueel- en teamleren, naar conflicten in teams en conflict management. De *combinatie* komt duidelijk minder voor...

De focus van dit onderzoek is op de 'zachte kant' van grote resultaatverplichte ICT ontwikkelprojecten; projecten waar een commerciële leverancier in opdracht van een klant een ICT systeem moet bouwen en opleveren. Projecten zoals die op dit moment dus weer erg in de belangstelling staan van politiek en pers.

Dit onderzoek gaat niet over aanbestedingsregels, over formele contracten of over ontwikkelmethoden. Het gaat over mensen, over het delen van kennis, over conflicten en conflict management. Het uitgangspunt is dat formele contracten weliswaar tussen organisaties worden afgesloten, maar dat het uiteindelijk de mensen zijn die het werk moeten doen. Mensen die samenwerken in sub teams (klant, leverancier) én die samenwerken in het grotere geheel van het zogenaamde 'multi team system' – de combinatie van klant- en leverancier subteams – dat als geheel verantwoordelijk is voor een succesvol te realiseren ICT systeem.

Het eerste deel van deze thesis geeft een geïntegreerd theoretisch model gebaseerd op literatuur uit onderzoeksstromen zoals outsourcing, ICT ontwikkeling, teams, conflict en mentale modellen. Dit wordt gevolgd door vier hoofdstukken waarin empirische data verkregen uit grote ICT projecten wordt gebruikt voor het toetsen van hypothesen betreffende de complexe dynamiek binnen en tussen de sub teams. Deze hoofdstukken behandelen verschillende soorten conflicten binnen teams; de rol die het reguleren van emoties heeft op conflicten; de effecten van gedeelde kennis en specialisatie op het resultaat van de teams. Het laatste deel van dit onderzoek ten slotte, geeft een uitgebreid en geïntegreerd overzicht van conclusies vertaald naar pragmatische DO's en DONT's voor managers.

Keywords: Multi-team systems, Multi-level research, Shared Knowledge, Specialization, Shared Mental Model, Transactive Memory, IS-development, Outsourcing, Conflict, Emotion Regulation

Abstract

While writing this abstract in June 2014, the Dutch government initiated (yet another) investigation into failing large ICT-projects in the public sector. Because such projects – both in the public and the commercial sectors – do fail frequently. Ample research on ICT-projects is available: research on outsourcing ICT-activities, ICT-governance, and organizational relationships and partnerships. Equally abundant is research on teams, individual and team learning, conflicts in teams, and conflict management. Research that *combines* these topics is not as readily available.

The focus of this research is on 'the soft side' of large ICT development projects; projects in which commercial vendors build and deliver a tailor-made ICT system on behalf of a client organization; the kind of projects that currently receive high levels of attention from politicians and press.

This research is not about legislation and tendering, it is not about formal contracts, and it is not about software development methods. It is about people; about sharing knowledge, about conflicts and conflict management. Formal contracts may exist between organizations; it is real people that have to do the actual work. These people have to work together in sub teams (client, vendor) and in the larger entity that is responsible for successfully producing an ICT-system and that is called the 'multi-team system' – the combination of client and vendor sub teams.

The first part of this thesis offers an integrated theoretical model that is based on literature review of various research streams: outsourcing, ICT-development, teams, conflict, and mental models. The second part consists of four of empirical chapters in which data from real large ICT projects is used to test hypotheses related to the complex dynamics within sub teams and across sub teams (the multi-team system level). These chapters discuss different types of conflict within teams, the role of emotion regulation on conflict development, and the effects of shared knowledge and specialization on team effectiveness. The final part of this thesis provides an extensive and integrated overview of conclusions and findings, translated to practical managerial DO's and DONT's.

Keywords: Multi-team systems, Multi-level research, Shared Knowledge, Specialization, Shared Mental Model, Transactive Memory, IS-development, Outsourcing, Conflict, Emotion Regulation

Foreword

"Hi love, how was your day? Oh, by the way, can you please make sure that we do not schedule anything social or fun for the weekend? That is: the next 350 weekends... ?"
Can you imagine your spouse's reaction? But essentially, this is reality when you start a PhD next to your normal daily job...

Above all...
Let me start by thanking my wife Irene for her immense patience and flexibility these past years!

Frustration...
When I mention 'frustration', I am (fortunately) not referring to my research itself. The research itself was challenging and rewarding at the same time. What I am referring to, is large Information System Development Projects that seem to be making the same mistakes over and over again. It is this frustration that got me started on this PhD research about seven years ago.

Motivation...
A practical desire to look at large projects from a different angle to try and increase success rate and a more personal wish to try something new, to do 'some serious research' and to work on a substantial intellectual challenge.

Letting go...
When I started this research, I worked as a management consultant for a large business and IT consultancy organization; a role in which I was used to taking a broad perspective on things. And I still remember those first (many) meetings with prof. dr. Marius Meeus in which we discussed the scope of this research. And I remember feeling that the scope became smaller and smaller... All the fun stuff I had in mind had to go because "too much, too wide, not enough focus". Of course Marius was right - next time (sorry Irene...) - I will choose a narrower topic...

Practical usage...
This research was always grounded in reality, in real life projects. And almost from day one, I was able to use the knowledge gained in daily life, in projects and in setting up governance structures for outsourced information system development projects. The research helped!

Waiting...
Waiting for people to respond to my request for projects and participation; waiting for questionnaires to be returned; waiting for journals to send feedback on papers. Waiting: not the most fun part...

Reading...
Endless reading... Partly because of the (still) wide scope of this research - touching upon IS-development, outsourcing, conflict literature, team literature, multi-team systems and partly as a result of plain curiosity... Reading one article leads to reading the next. Time consuming but rewarding!

Learning...
Learning from other scholars' articles, learning from discussions with fellow PhD researchers, learning from discussions with prof. dr. Marius Meeus and dr. Petru Curşeu, learning from applying the knowledge in practice.

Thanking...
Prof. dr. Marius Meeus for his patience, his often out-of-the -box perspective on things, and his critical but always constructive questions and comments.

Very (very!) special thanks to dr. Petru Curşeu, my co-promotor and, more importantly, the person without whom I don't think I would have made it. Petru's never ending support, practical help and motivating words made a huge positive difference. It was always fun, interesting and helpful to spend a few hours sparring. Petru: without exception, I left my meetings with you happier and more motivated than I entered them. Thanks!

And once again, thanks and love to Irene: without your support I most certainly would not have been able to see this through.

A lot of reading, a lot of writing, a lot of work, a lot of discussion, a lot of waiting, a lot of weekends, a lot of patience (mainly from others!). But also, and more importantly: a lot of fun!

And of course... a special word of gratitude to all the people who helped make this research possible: first of all the people who took the time and effort to fill in the questionnaire and in doing so provided the data used for the empirical chapters in this thesis - people I don't even know but who were willing to spend their time and effort: thank you!; the people from CGI (my employer at the start of this research, formerly known as Logica and LogicaCMG) who motivated me to start this research project (special thanks to Louis); the liaisons from the client companies who were kind enough to support me, who distributed questionnaires and who motivated their colleagues to fill in the questionnaire; the liaisons from CGI who helped me find projects and who distributed the questionnaire among project team members; the colleagues who helped testing the questionnaire, translating and checking scales, double checking the coding of results; the administrative support in sending, distributing, collecting questionnaires, setting up meetings; the people from CGI who initiated the research project together with Tilburg University; my fellow external PhD students with whom I had a number of interesting and motivating meetings; and the no doubt many others that I failed to mention.

Thank you: Alexander B., Ali T., Andries v E., Anneke G., Arend S., Arjan B., Arjan den O., Barbara H., Belinde B., Bert P., Bram K., Brigitte T., Cees vd K., Edward J., Edwin H., Edwin K., Ellen de B ., Erik V., Erwin d J., Erwin S.G., Evert N., Francois d L., Frank M., Frank S., Frank V., Franka B., Frans V., Fred S., Frien v K., Geesje M., Geleyn M., Gitta G., Hans v C., Haye M., Helen A., Herman B., Herman K., Inge G., J. Sl., Jan P., Jan R., Jean-Paul S., Jeroen S., Jeroen vd V., Jinze B., Jorg V., Juerg F., Jurrial B., Kees v R., Laurens vd B., Louis F., Louis T., Lucien K., Marja H., Mark K., Martijn v B., Martin d L., Mikko L., Monique v B., P.G. v E., R. Kl., Raber S., Raymond E., Rein t N ., René R., Robert H., Robert-Jan P., Rolf B., Ronald D., Ronald v P., Rudy d H., Ruud H., Sander K., Sjaak O., Sjaak v D., Sjors T., Suresch v R., Thomas M., Ton M., Wim G., Wim M.

And, once again: thanks to all the respondents, whom I don't know by name, who filled in and returned the questionnaire!

Walter van den Berg
Barendrecht, the Netherlands, May 2014

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CHAPTER 1

Introduction

1.1 | Champagne and happy faces!

You have all seen the photographs...
Pictures of smiling executives surrounded by a group of happy employees, drinking champagne after they signed a large Information Systems development contract. A moment of glory after a typically lengthy process of (a) writing an extensive Request for Proposal (client), (b) answering this RFP by an equally impressive pile of paperwork (vendor), and (c) a period of some serious negotiating on conditions, price and other legal and contractual issues. This is the moment where everyone genuinely is fully confident that this will be the beginning of a '*long-term partnership between our companies from which we will both benefit whilst achieving our shared objectives*'. Let the honeymoon begin (inspired by Fichman & Levinthal, 1991).

And although one might say that naivety is a virtue, we can also ask ourselves the question 'will we ever learn?' Because reality *will* kick in, the honeymoon period *will* end, and the client-vendor relationship *will* run into two fundamental dilemmas that seem to be an integral part of these types of relationships...

The first dilemma can be summarized in one word: shared. In English (as in Dutch), the word shared (gedeeld) has two opposite meanings: shared as 'in common' (as in shared knowledge) versus shared as 'distributed' (as in sharing the pie). In the context of Information Systems development outsourcing, this dilemma manifests itself in the struggle between investing in shared knowledge, mutual understanding, and common ground versus the pressure on cost savings, on time schedule and on an inherent emphasis on specialization and artifact driven client/vendor interfacing.

The second dilemma is related to distal versus proximal goals. Although the client/vendor relationship will have a common (distal) goal (in the end: producing a high quality, implemented and actively used Information System), there will also be proximal goals for both client and vendor companies; proximal goals that are not shared-as-in-common but may even be contradictory (money spent versus revenue being the simplest example).

Taking these two dilemmas as a starting point, this thesis focuses on **Outsourced Information System Development Projects** (**OISDP**s). More specifically, it focuses on the client-vendor **Multi-Team Systems** (**MTS**s) that are responsible for such projects. The thesis offers a literature review, a theoretical model on the dynamics of these Multi-Team Systems, empirical chapters, and an extensive managerial chapter with practical DO's and DONT's based on theory and findings. Related to dilemma 1 this thesis discusses the importance and role of Shared Knowledge (in both meanings of the word shared); related to dilemma 2 it discusses conflict, conflict dynamics (spillover, transformation), and conflict management in the multilevel context provided by Outsourced Information System Development MTSs.

1.2 | Outline of this thesis

The first chapter in this thesis is introductory and establishes the fundamental underlying dilemmas that this thesis and research are all about. This brief outline supports you in deciding what may or may not be of relevance to you. In the remainder of this first chapter I will introduce you to the context of this research – that of outsourced information system development projects (**OISDP**s). I will introduce you to the importance of the topic and, using a somewhat cynical approach, to what seems to be going wrong with these projects. Again and again. And again… A discussion of key characteristics of outsourcing in general and of OISDPs in particular follows. After identifying a gap in current literature, the scope of this thesis is discussed as are the primary research questions that I am trying to answer.

After introducing the OISDP's prisoners' dilemma, the chapter concludes with the contributions (scientific and managerial) of this research and explains the research strategy.

Chapter 2 is a theoretical chapter containing a review of relevant literature. It is split in an initial literature review part (a quick glance) and a detailed review that first looks at Information Systems (IS) development and its outcomes and at variables found to impact that outcome. It follows with a discussion on team and team dynamics covering processes, affect, and cognition.

Based on the literature review, the next paragraph introduces a conceptual framework that is grounded in findings from previous research and literature. Using a thought experiment involving a 2x2 jigsaw puzzle, the conceptualization of team cognition is discussed and included in an overall conceptual model of OISDP Multi-team dynamics. The final paragraph of chapter 2 uses this dynamic model and effectively constitutes a theoretical chapter offering a number of propositions on the role of team cognition in OISDP Multi-team Systems.

Chapter 3 reflects on the research methodology, covers the research that underlies the empirical chapters of this thesis, explains the data collection approach, discusses the operationalization of the various team cognition elements, and explains a formula to calculate sharedness that was specifically created for this research to deal with open text survey responses and sparse data. It further discusses the scales used in the data collection process.

Chapter 4 through 7 are the empirical chapters that each zoom in on a part of the conceptual model that was defined in chapter 2. The empirical chapters focus on conflict dynamics, emotional regulation as moderator of conflict transformation, conflict management, and finally on team cognition and its impact on team outcome.

Chapter 4 is the first empirical chapter. It discusses multilevel, *intra*-domain conflict spillover and *inter*-domain conflict transformation in multi-team IS development teams.

Chapter 5 discusses findings on emotional regulation and its moderation effect on conflict transformation.

Chapter 6 complements the conflict related chapters with findings on the effects of various conflict management approaches on conflict spillover.

Chapter 7 is the last empirical chapter in this thesis where I come back to the integrated model by relating shared knowledge to outcome of multi-team IS development systems and leverage and include the insights from the research into conflict spillover and transformation.

Chapter 8 is the concluding chapter in which I reflect and look back through a number of notes on methodology, findings and future research. I finish this chapter with a paragraph that covers what this all started with: an integrative managerial model and suggested practical interventions to support OISDP managers.

The appendices at the end of this thesis will provide you with additional tables and figures.
I wish you happy reading.

1.3 | Outsourced Information Systems Development Projects (OISDPs)

IT-outsourcing continues to grow in today's marketplace and outsourced Information Systems development is one of its forms. Although research in this field has proliferated in the past two decades, we still see that many projects and client/vendor relationships struggle.

One of the characteristics of Outsourced Information System development projects is that they involve both client and vendor (sub) teams that together form a multi-team system (MTS) responsible for successfully building and delivering the required information system. It can be expected that cooperation within and between these sub teams is of relevance to the success of OISDPs. The dynamics in these sub teams and in the MTS are the focal point of this research. My aim is to better understand these dynamics and, in doing so, provide practical pointers to increase chances on success by providing a theoretical model followed by empirical research using real MTS project teams.

This thesis starts from the assumption that various streams of research – outsourcing, information systems development, conflict, and team research (including Multi-Team Systems) – do not reflect *different* realities but merely *different perspectives* on the same reality. Based on literature from these research streams, this thesis strives to integrate these different perspectives into a coherent theoretical model. A model based on an innovative multi-dimensional taxonomy of variables (behavioral, cognitive, affective and process, dynamic state, emergent state) that allows for further

empirical research into the concept of team cognition as applied to the client and vendor sub teams in OISDPs.

1.4 | Will we ever learn?

In daily life, we tend to group people into two types: pessimists *(the glass is half empty)* and optimists *(the glass is half full)*. But we rarely consider (or encounter) that third type of people... People who, if asked their opinion of this important matter, will reply by saying: '*Who cares if it's half full or half empty: let's just find a tap and fill it up!*'

I believe that in the field of Outsourced IS Development we could benefit enormously from trying to find a tap instead of fighting over half full versus half empty...

And that, in essence, is what started this research.

Suppose you felt inclined to write a somewhat cynical handbook on outsourced IS development projects.

Your first chapter might be called '*historical context – lessons learned from the past*'. You would probably start by doing some research on historical outsourcing projects and you would quickly find quotes such as: (a) "*both sides realized that the relationship required an integration of efforts, which could only be achieved through a high degree of cooperation. However, the very existence of price based control clauses within the contract ensured that price controls would be operative, which created a disconnect between the contract and the need for cooperative controls*" (Miranda & Kavan, 2005); (b) "*While both parties came to believe that trust was an important part of the relationship, Xerox and EDS initially believed the other to be exclusively self-interested and that the relationship was no different than our relationship with anyone else who supplies us with parts*" (Miranda & Kavan, 2005).
Both citations refer to an IS outsourcing deal between EDS and Xerox in 1988. That is: 1988... You, being the author of a cynical book, might then conclude your first chapter by stating that as of now, end of 2013 and 25 years later, nothing really changed. Clients and vendors in outsourced IS development projects are still spending far too much time and effort fighting about 'empty or full' as opposed to looking for a tap...

Being determined to not let this disappointment stop you, you eagerly start your second book chapter and decide to use some reverse psychology to wake up the audience: '*Chapter 2: Tips to guarantee IS development outsourcing failure*'. In this chapter, you provide your innocent readers with tips and tricks such as:

– Make sure that both client and vendor in the outsourced IS development relationship have to spend loads of time and money to (a) prepare a solid Request for Proposal, and (b) write a 1,400 page proposal;

- Suggest that they hire dozens of lawyers to make sure that the relationship starts with as thick a contract as possible, describing all possible [not!!!] contingencies and defining exactly what each party has to do and deliver over the next three to five years;
- Finally, delay contract signing as long as you can by fighting over minute details but, as soon as the contract is signed, make sure that there is a very tight deadline for the first products to be delivered. To be more precise: whatever you do: make sure that the people who need to do the actual work will have as little time as possible (and limited budget) to get acquainted with each other and the task at hand...

By now, your readers should get the point.
The frustrating part is that your hypothetical cynical book does seem to reflect today's reality but all too well...We have been struggling with outsourced IS development for decades. And there truly are many reasons and factors that make these projects difficult - both for clients and vendors.

Let's stop wasting time. Let's try and find a tap to fill that glass!

1.5 | Outsourced Information Systems Development: what's so interesting about that?

"The third party provision of IT products and services."
This is one of the many definitions of (IT-) outsourcing and it is the definition that I will follow in this research. It is a broad definition, including large scale outsourced information systems development projects. In this research, I focus on Information Systems development services provisioned by and under the contractual responsibility of a vendor.

Growing Importance, practical relevance

Outsourcing has been a key method for managing IT and systems (Kishore et al., 2003). Its importance and market volume continues to grow. Press and literature confirm that software outsourcing has grown steadily over the last decade (Oza 2006). Due to the ever growing demand for software products and the rapid and sweeping changes in technology, an increasing number of organizations are outsourcing all or part of their software development activities (Whitten, 1995). According to studies by commercial market research institutes such as the Yankee Group and Dataquest, global revenues for outsourcing have been growing rapidly. About half of companies with IS budgets of $5 million or more are either outsourcing or evaluating to do so according to a survey of 1200 companies (Dibbern et al., 2004). It follows that management attention for IT-outsourcing becomes more and more important (Beulen & Ribbers, 2002).

What drives outsourcing? Specialization

The most frequently cited reason for outsourcing is the need to reduce and control cost (Levina & Ross, 2003; Ang & Straub, 1998; Loh & Venkatraman, 1992). Lacity and Willcocks (1998) found that

the reasons for outsourcing were directly related to financial expectations and outcomes in 48 of 61 cases. A second key reason for outsourcing is access to technical talent that is unavailable in-house (Levina & Ross, 2003; Lacity & Willcocks, 1998) and the need to outsource peripheral or non-core activities so that companies can focus more on their core business (Lambert, 2005).

What these drivers have in common is their link to (or even dependency upon) *specialization*.
Cost reduction as a result of outsourcing will only materialize if the vendor can build Information Systems against a lower cost model than the client themselves would be able to. This suggests specialized vendors who, presumably, benefit from economy of scale or economy of skill (in the field of IS development). Access to technical talent and focus on core activities are even more directly related to specialization: the former suggests that specialized technical talent must be found outside the client organization, the latter suggests that the client organization wants or needs to specialize in their own core business – and therefore outsource their non core activities such as IS development.

'Growing pains' or 'growing *pain*'?

Many outsourced large software development projects do not deliver a satisfactory cost effective product on time and anticipated financial benefits are often not achieved (Aron & Singh, 2005; Levina & Ross, 2003). These projects have a reputation that they fail to deliver their expected benefits or, when they do so, they often are too late and too expensive. A report on behalf of the Dutch government (Algemene rekenkamer, 2007)[1] starts by claiming that ICT projects are more expensive, take more time and fail to deliver the required result[2]. Dekker (2007) claim that the Dutch government alone spends € 4 to € 5 billion yearly on completely or partially failed projects. Although the article (Algemene Rekenkamer, 2007) does not take these numbers at face value, the statement is that the problems are substantial. In May 2014, a new government initiative on large projects is ongoing leading to newspaper headlines such as *"Over six years late, 413% cost overrun. But considered a success!"*[3] Similarly, the track record of outsourcing shows serious issues: Often the expected financial (cost or otherwise) benefits in outsourcing projects are not achieved (Aron & Singh, 2005; Levina & Ross, 2003); according to research of the Gartner group 45% of all outsourcing relations are perceived as insufficient (de Heus, 2007).
These issues might – optimistically – be called *growing* pains in a still relatively young industry; we can also consider them as a growing *pain*. No matter which of these perspectives you prefer, I believe that a better understanding of the dynamics of client/vendor cooperation in these outsourced IS development projects can provide levers to improve the chances on successful outsourced IS-projects.

[1] No author specified.

[2] The report discusses large government ICT-projects that fail to deliver – either fail entirely or delivery is too expensive and / or too late.

[3] NRC handelsblad, May 10, 2014

Conceptual background – Characteristics of OISDPs

The 'O' in OISDP implies that we have to deal with at least two different organizations: the client organization and the vendor organization. This suggests that outsourcing and client-vendor relationships are of relevance to this research. The 'ISD' part suggests application development and IS development may provide interesting viewpoints. The 'P' in turn signals that we have to deal with temporary projects teams who have to deliver predefined results against an established budget, and within an agreed upon timeframe.

The fact that OISDP MTSs have to deal with both client and vendor sub teams that do share a common goal, further suggests that the concept of Multi-Team Systems (MTS) may provide useful insights. Multi-team Systems (**MTS**s) are defined as two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals. MTS boundaries are defined by virtue of the fact that all teams within the system, while pursuing different proximal goals, share at least one common distal goal; and in so doing exhibit input, process, and outcome interdependence with at least one other team in the system (Mathieu et al., 2001).

Outsourcing literature provides various perspectives including:

- *Transaction Cost theory:* Success depends on managing transactions efficiency. The theory assumes: (1) limited rationality (stating that it is only possible to enter into incomplete contracts) which is an issue since the theory also assumes (2) opportunistic behavior (parties will cunningly take advantage of opportunities at the expense of others).
- *Relationship / relational exchange theories:* Relationship theories focus on cooperation, interactions, and social and economic exchanges as major factors in inter-organizational relationships (Dibbern et al., 2004). More specifically, they focus on interactions between parties that are geared towards the joint accomplishment of the individual party's objectives. The theory is frequently used in vendor-buyer relationships and is the basis for the outsourcing work by Klepper (1995) and Kern (1997). The underlying idea is the notion that at the root of all relationships is some type of exchange and that parties to an exchange are in mutual agreement that the resulting outcomes of the exchange are greater than could be achieved otherwise. This motivates the parties to consider the relationship important in and of itself, and to devote resources towards its development and maintenance. Relational Exchange Theory holds that transactions between parties are increasingly governed by processes based on informally negotiated rules of exchange (Holmström et al., 2006) and states that exchanges between parties in a relationship are shaped by a set of expectations about behavior that are shared between these partners.
- *Social Exchange theory:* Social Exchange is defined as: 'voluntary actions of individuals that are motivated by the returns they are expected to bring and typically do in fact bring from others' (Dibbern et al., 2004). Key attributes are reciprocity, balance, cohesion, and power.

Literature on IS development teaches us that, since the development and delivery of software products and services exceeds the capacity of individuals, work on these products must be divided and coordinated (Kotlarsky et al., 2008). This statement was true when companies did their own internal IS development and still holds when IS development work is outsourced. In the case of in-house IS development projects, this suggests that a project team will be set up. In the outsourced context, this means that both the client and vendor organizations will have teams responsible for their (specialized) parts of the work. IS development can be seen as a process consisting of various steps, some of which will be the responsibility and the work of the client organization, others will be performed by and under responsibility of the vendor organization. Although the exact division of labor and responsibilities may differ from case to case and depends on the software development methodology chosen, there will always be a need for interfacing (and hence interaction) between client and vendor sub teams at the points in the process where responsibility moves from one party to the other.

Team research states that collectives – defined as any interdependent and goal directed combination of individuals, groups, departments, organizations, or institutions – can and should be studied as systems of interaction (Morgeson & Hofmann, 1999). Teams are defined as: a set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal, each having specific roles or functions to perform and a limited lifespan of membership (DeShon et al., 2004). In the case of outsourcing IS development, reality is that (representatives of) two organizations work together in order to achieve a common goal. Although they will work from within their own sub teams, the definition as provided above holds – there is a common and valued goal – if only the formal contract. Corroborating this notion is the statement by Evans et al. (2004) *"a team can consist of two or more people or groups of people (i.e. teams of teams) "*.

A complementing point of view is provided by Mathieu et al. (2001) in their discussion of Multi-Team Systems. MTSs can consist of sub teams that belong to more than one organization. The five distinguishing characteristics that the authors attribute to MTSs[4] all apply to the OISDP teams that are the topic of this thesis.

In contemporary research, it has become clear that multiple factors, both behavioral and cognitive in nature, play a role in team performance (Cooke et al., 2003). A strictly behavioral perspective does not for instance take into account that there is an inherent adversarial nature in the [outsourcing] contracts such as cost saving goal (outsourcing company) versus return on investment (vendor) (Beulen, 2004). Lacity and Willcocks (2003) emphasize the need to embrace the dynamics and development potential as the primary success factor of an outsourcing relationship (Jahner, 2007).

In this thesis, I take a stance similar to that of Kozlowski and Ilgen (2006). A contemporary perspective that conceptualizes the team as embedded in a multilevel system that has individual, team, and

[4] Composed of two or more teams; unique entities between 'team and organization'; input, process, and output interdependence; open systems; common super ordinate goal.

organizational level aspects and which focuses centrally on task relevant processes incorporating temporal dynamics (Kozlowski & Ilgen, 2006). Teams are dynamic systems that interact and that interpret and develop over time as a result of such interaction. Especially in the context of OISDPs, the parent organizational systems (plural – client and vendor) that the sub teams belong to must be taken into account. The perspective taken in this thesis is that of a multi-team system consisting of sub teams from different parent organizations. Kozlowski and Klein (2000) suggest that *"virtually all organizational phenomena are embedded in a higher-level context"* and *"multilevel theoretical models are relevant to the vast majority of organizational phenomena".*

As Beulen and Ribbers (2002) point out, research attention for the management of IT outsourcing partnerships has been limited; at the same time, *"managing an interorganizational partnership relationship is basically a management problem"* (Beulen & Ribbers, 2002). For combining these various viewpoints, I find support in research by Miranda and Kavan (2005), Sabherwal (1999), Kern (1997), Ring and Van De Ven (1994) who show that outsourcing relationships are found to rely on both a formal as well as a psychological contract (Miranda & Kavan, 2005; Sabherwal 1999). Influencing elements include feelings of trust towards one another, shared language and cognitive resources, and common knowledge – that is, shared identity, beliefs, expectations, and understandings. The psychological contract emerges and in fact exists between people (Ring & Van De Ven, 1994) as a result of interaction between those people, who are representatives of client and vendor: a bond between two firms implies tying together of relations between partners […] the development of the relationship depends on social and personal bonds (Kern , 1997).

In summary: the stance in this thesis is that, although IS outsourcing contracts exist between organizations; it is real people doing the work. Therefore: studying the interplay in the multi-team system is of relevance and a deeper understanding of the dynamics that take place within the MTS and Sub Teams is of importance to better understand and manage such complex outsourced IS development projects.
In this thesis, I will borrow from the underlying foundations listed above, use the team dynamics perspective as the focal point of this research and use IS development and outsourcing to provide the context.

1.6 | A gap in current literature, scientific relevance

Literature on outsourcing and client relationships in outsourcing is abundant. One can also find extensive literature on conflict and, similarly, on team cognition, shared mental models, and transactive memory. One can even find even literature that touches upon combinations of these topics - such as shared mental models in IS development teams or conflicts in outsourcing. I did however, not find any research that integrates the dynamics of outsourced IS development projects and that reflects (a) the multilevel aspects inherent in a multi-team system and (b) the complex interplay that can be expected to occur both within and across teams and that combines insights

derived from multi-team systems and team cognition to develop an integrated conceptual framework.

As the streams mentioned have been researched before, the aim of this research is to leverage and combine insights and findings from existing research, to apply those insights to a complex multi-team and multilevel situation and to test those insights in a real world context.

In doing so, this thesis aims to add to the existing knowledge base by extending the insights on MTS dynamics by exploring important aspects such as conflict, conflict spillover and conflict transformation within and across team levels. Relationships between conflict types in the context of IS Multi-team-systems are – as far as I know – not reported upon before. I also aim to expand on previous research on intra group conflict by investigating the interplay of task, process and relationship conflict in a real world multi (project) team systems setting. DeChurch and Marks (2006) suggested that future research is needed in more applied field settings; research that explores how systems of teams interact effectively and research into interventions for leveraging their success. This thesis responds to this suggestion by looking at the interaction (both intra sub team and inter sub team) in Multi-Team Systems of client and vendor in outsourced IS development projects. In addition, previous research pointed towards the need to explore intra group conflict further in a comprehensive multi-dimensional way, by including both individual perceptions and group level aggregates (Jehn et al., 2010). This study adds yet another level to this multi-dimensional dynamics of conflict in teams, namely the inter group dimension, which is deemed highly important for MTS dynamics.

A focal topic is team cognition. Team literature suggests that shared task understanding emerges over time as a result of interaction and team learning processes and is beneficial for performance (Cooke et al., 2003). In this research, I focus on shared task understanding, on specialization and the interplay between them in the context of the multilevel dynamics of the MTS. I aim to answer the call for more dynamic models of team functioning and team performance (Ilgen et al., 2005) and to add to the team cognition literature by distinguishing between various types of knowledge sharing and their effect in real life MTSs. I will discuss shared-as-in-common and shared-as-distributed and the paradox that in OISDPs, both forms of sharedness are necessary. In addition, the research contributes to the literature on team cognition by highlighting the need to address the role of shared mental models in a dynamic perspective. I explore the role of shared knowledge on team performance in distinct performance episodes.

1.7 | Scope: MTS, Inter- and Intra-team dynamics, conflict and cognition

As discussed in the previous paragraph, there are many different perspectives one can take to look at the phenomenon of OISDPs leading to many research streams to be considered. Streams that in turn will provide numerous sub streams. In-depth research into all the potential variables that may

influence the effectiveness of OISDP MTSs is clearly too ambitious a goal. My interest in this topic – and the start of this research project – began with daily experience in large projects that all seem to struggle with similar issues: people from different organizations who have to work together to achieve a common goal. People who struggle to do so because they are driven both by this common goal and by other, non-common or even contradicting goals as a result of their different parent companies.

For this reason, I chose to make the team dynamics perspective the focal point of this research and use IS development and outsourcing to provide the context. More specifically, the focus of the empirical research is on team dynamic elements that I consider to be of specific interest given the MTS context: conflict and shared knowledge.

Conflict in the context of OISDPs is an interesting topic for various reasons: (a) tension is *inherently built into* the OISDP client/vendor relationship (and therefore conflict can be expected to be unavoidable) as a result of interdependent and conflicting proximal goals (vendor's revenue is client's expenditure), (b) this is substantiated by experience with large outsourced IS development projects that shows that conflict is inevitable during the lifecycle of the project, (c) conflict has been found to impact team performance suggesting that understanding conflict dynamics is of importance, (d) besides the negative effects that conflict can have, findings have shown that (task related and process related) conflict can also benefit team performance in knowledge intensive teams, implying a possibility to *use* conflict to improve team performance, and (e) conflict is a topic that can be studied on multiple levels (individual, sub team, MTS).

Shared Knowledge is relevant because (a) the fact that people in two sub teams have to somehow cooperate to produce one product suggests that a certain level of shared knowledge (if only regarding the required result) is a necessity and prerequisite for success whereas on the other hand (b) the build-up of shared knowledge takes time, effort and resources and as such (c) seemingly contradicts the notion of specialization that is inherent in outsourcing. Again I see an almost inherent paradox: building shared knowledge is a necessary precondition for success versus contextual influences pushing towards specialization (outsourcing focuses on cost reduction and depends on specialization). As with conflict, this inherent paradox makes Shared Knowledge an interesting topic in our context.

Both conflict and shared knowledge are topics that any MTS OISDP team will have to deal with in order to be successful. A better understanding of these topics is therefore of importance to increase the chances of improving the future success rate of OISDPs. This primary focus by no means suggests that other elements (trust, communication, coordination, and commitment to name but a few potential candidates) are not important. More than that: my aim in this research from the start was to define an overall comprehensive theoretical framework for the OISDP team dynamics, inspired by existing literature and verified by existing findings and then to zoom in on conflict and shared knowledge through empirical research. The empirical research in this study uses real life

outsourced IS development projects in the Netherlands. Within the scope of these projects, I take a multilevel perspective by investigating individual, sub team (client, vendor) and Multi-Team system level variables. The primary focus is on the role that shared knowledge or in more general terms team cognition and conflict have in these teams.

1.8 | Research objectives and Questions

"*Software teams provide an ideal situation in which to study shared mental models because the focal projects are relatively complex, dynamic, and unstructured. Team members are jointly responsible for the end product and so must negotiate shared understandings about both the teamwork and the task.*" (Levesque et al., 2001).

The Prisoners' dilemma game[5]

The prisoners' dilemma is a well known example from game theory. The structure of the prisoners' dilemma was created by Merrill Flood and Melvin Dresher in 1950 (US Airforce, Project Rand, Experimental games) as part of the Rand Corporation's investigations into game theory (Kuhn, 2014, Augenstein, 1993). The title of prisoners' dilemma allegedly was coined by Albert Tucker.

Despite the good intentions that both client and vendor will have at the beginning of their contractual Outsourced IS development Project, reality after a while often resembles the so called prisoners' dilemma: two people were spotted near a crime scene and are suspects – the police do not have sufficient evidence to convict both. The two suspects (say Barry O. and Teddy C.) separately are confronted with a choice: if neither Barry nor Teddy confesses, both will get off relatively easily with a one year prison sentence; if Barry O. confesses, he will be set free and Teddy C. goes to prison for ten years (and vice versa); finally, if both confess to the crime, both will be sentenced to five years of imprisonment.

A summary of the options:

Table 1 | Prisoners' dilemma

The Prisoners' dilemma		
	Teddy C. keeps silent	Teddy C. talks (betrays or defects)
Barry O. keeps silent	Both sentenced to 1 year	Teddy walks, Barry gets 10 years
Barry O. talks (betrays / defects)	Barry walks, Teddy gets 10 years	Both sentenced to 5 years

In the prisoners' dilemma, a paradox appears. As a whole, keeping silent is clearly the best option – in total only two years of imprisonment (2x1) whereas the other three options each lead to ten years

[5] Paragraph inspired by Lodewijkx (2011)

in total (either 1x10 or 2x5). However, from a personal perspective, the individual, *regardless of what the other does*, is better off by *defecting*.
Take Barry O. as the example: if Teddy C. stays silent, Barry should talk since that will set him free as opposed to getting a one year sentence by remaining silent. If Teddy C. *defects*, again, Barry O. should talk as well since his punishment will then be five years instead of ten. Therefore: each individual, rationally, decides to *defect*. This clearly leads to a non-optimal result for the collective of the two prisoners.

The OISDP's prisoners' dilemma...
The analogy applies well to our Multi-team System (albeit on an organizational level as opposed to a personal one). The two companies are in a sense 'prisoners' in being bound by a mutual contract that neither of them can simply walk away from. OISD projects almost inevitably lead to conflict situations regarding *in or out of scope* discussions. The vendor will easily claim that deliverables or requirements are out of scope leading to additional work and revenue whereas the client's interest is exactly the opposite.
This is similar to the prisoners' dilemma in the sense that overall, the optimal solution is to stick together and work out a solution (and keep focusing on that distal common MTS goal of providing the right Information System) or perhaps mutually decide to end the contract. However, the rational and proximal interest of optimizing their own situations may lead to *defection* and, in real life, conflicts, and lawsuits. To illustrate: whilst writing this thesis, the Dutch government – again – is investigating large, failed ICT projects and Dutch newspapers are filled with examples of large government organizations entering into contracts with large IS-development companies. Contracts that, in retrospect, both organizations admit were too good to be true to start with. The vendor offers against an unrealistic price in order to win the deal, the client – who should (and did) know better – accepted, and the project starts and in the end turns out to have cost four times as much as the original contract specified. This to the expense of both client and vendor. They could have stuck together, openly discuss the situation and try to solve it, meet halfway (and accept, in our analogy, the 2x1 years of punishment). Instead, both client and vendor defected in the sense that they went into fighting mode each hoping to come out on top: the client aiming for the unrealistic no additional cost relative to contract (suggesting that 'it's all the vendors fault'), the vendor aiming to blame the client for incomplete specifications and trying to get as much out of the project as possible. In the end, both lose...

Since no analogy is perfect, neither is this one. The main difference with the traditional prisoners' dilemma is that in the OISDP case, the two parties are not locked up in different cells without contact – they can actually communicate. From this perspective, the prisoners' dilemma in OISDPs is more of an open conflict than it is in the case of Barry O. and Teddy C. The fact that the two 'prisoners' in the OISDP context can communicate should (could) be a tremendous benefit; it allows the parties to negotiate, to learn about each other's opinions, goals, motivations and, in doing so, might help to actually prevent the conflicts from occurring. That is: mutual understanding, sharing information, shared knowledge might be one of the levers to, overall, optimize the success rate of OISDPs.

Following the analogy: my ambition with this research is to (a) build a theoretical model that helps to better understand the MTS dynamics (b) identify managerially usable levers to improve OISDP success, (c) identify mechanisms to more effectively deal with conflict in OISDPs.

This leads to the following research questions:

- *RQ-1:* Overall: Based on (combining) existing literature and findings, can I create a theoretical model that supports a better understanding of the complex dynamics in Multi-Team Systems that are responsible for success or failure of Outsourced Information Systems Development Projects. The aim is to describe a theoretical model grounded in existing literature that functions as a starting point for the empirical part of this research. Although the focus is on conflict and team cognition, the overall model will be more comprehensive.
- *RQ-2:* Cognitive: (a) which cognition related constructs (shared mental models, transactive memory) play a role in OISDPs and (b) how do they influence OISDP success. Cognition is considered to be a relatively well manageable aspect (for instance by training and knowledge sharing). From this perspective: the aim is to not only understand the role of cognition related constructs but also to provide practical 'buttons to press'.
- *RQ-3:* Conflict: (a) what types of conflict can we distinguish in OISDPs, (b) what roles do these types of conflict play, (c) how do they interact, and as a consequence (d) how can we proactively and effectively deal with conflict.

1.9 | Contributions of this research

Theoretical

First, this research offers a broad theoretical framework that identifies factors relevant to success in outsourced IS development projects and that supports a better understanding of such projects. In doing so, it combines a number of research streams into a coherent model and applies the results to a real life, socially relevant situation.

Second, it synthesizes the apparently opposite interpretations of shared knowledge (shared-as-in-common versus shared-as-distributed) and shows that both contradictory forms of sharedness are of great importance in OISDPs.

Third, this research investigates the role that process-, task-, and relationship conflict play in our project teams and adds to this by taking a dynamic perspective on conflict transformation.

Fourth, this research follows the calls for more insight into multilevel analysis by applying our models and research to a Multi-team System environment.

The research is not only grounded in existing theory but also in empirical, real life research in real commercial outsourced IS development projects.

Practical

Being a practitioner myself, this research started from daily experience and from practical issues in large OISD projects. The theoretical model can be used as an awareness tool to help project-, delivery- and contract managers from both client and vendor organizations, to better understand the complexities of OISDPs and, in doing so, help them better prepare to deal with these complexities. The combination of outsourcing, IS and team literature into one comprehensive model will also broaden the toolset that managers have available and may provide them with additional insights.

The empirical research on team cognition delivers practical pointers to temporal and timing issues (when to invest in which type of knowledge); pointers that can help increase effectiveness and efficiency in the Multi-team System as well as in the sub teams. The empirical results on conflict show that it is important to distinguish between different types of conflict (process-, task-, and relationship) because each of these types plays different roles. Understanding this distinction allows for the actual use of task and process conflict to benefit performance whilst preventing them transforming into (detrimental) relationship conflict. That is: managers can consciously manage and use conflict to increase chances on success in their teams.

In addition, I combine shared knowledge and conflict and relate this combination to the well-known managerial stages defined by Maslow (Unconscious Incompetence, Conscious Incompetence, Conscious Competence, and Unconscious Competence) to allow managers to actively guide their teams.

1.10 | Research Strategy

My initial literature review took a broad perspective by looking at literature related to Outsourcing, IS development and Team research. I created a model based on the long list of variables and constructs found; a model that would function as the foundation for the empirical research.

As described in paragraph 1.8, the research questions focus on team cognition and conflict. With a strong emphasis on team knowledge, Cooke et al. (2000) provides insights in various elicitation methods. The authors suggest four categories of elicitation methods appropriate for research on team knowledge (observations, interviews and surveys, process tracing, and conceptual methods). On interviews and surveys, Cooke et al. (2000) state that these are especially useful for: general understanding, generating and verifying hypotheses; to measure team mental models which are thought to be less context-dependent and more stable over time than team situation models. All of the above apply to the OISDP MTS context of this research. In addition, the literature review had shown that proven and widely accepted scales are available for measuring conflict and conflict management. These considerations combined with practical limitations led to the conclusion that I would base my empirical research on surveys (questionnaires) instead of, for instance, a small number of in-depth case studies.

Data for empirical real life (as opposed to lab) research is notoriously difficult to collect. This is even more so when the real world consists of time-pressured projects. This is why I decided to collect data from projects in one go, and to collect a broad set of variables in the questionnaires. The downside of this approach is that respondents required more time to fill in the – quite extensive – questionnaire; the upside is that I only had to ask respondents (through organizations' liaisons) to participate only once.

Outsourced IS development projects come in many forms. From projects where supplier teams work on site at clients' offices to project with large teams of off-shored staff in for instance India, or near-shored staff. Cultural and ethnic differences may have (can be expected to have) an effect on knowledge sharing, on communication, and on conflict management. Since cultural and ethnic differences are not the focus of my research, I decided to exclude projects that contain near- of off-shore staff, in essence controlling for such differences.

Similarly, collocated teams can be expected to have ample opportunity for informal communication and knowledge sharing. Given my interest in the paradox of shared-as-in-common knowledge being needed to achieve the benefits of shared-as-distributed knowledge, collocated development teams constitute a difficult group since informal communication would be difficult to control for. Therefore I decided to exclude collocated project teams.

Another criterion is project size (both in number of people as well as duration). I decided to set minimum thresholds of four people per (sub) team, six months (minimum project duration).

In short: my target outsourced IS-development project population consisted of projects (duration minimum of six months) staffed by non-collocated, local (Netherlands-based), sub teams (minimum of four people each) of client and vendor organizations.

Another research consideration is related to temporal effects. The decision to collect data 'in one go' apparently excludes the possibility of longitudinal research. Given the ambition to analyze team dynamics such as the development of shared knowledge, this posed a dilemma. The intended solution can be found in the inclusion of performance episodes in the questionnaire. Respondents were asked to specify the performance episode the project was in. Whereas the research design does not allow me to follow a specific project over time, the usage of performance episodes theoretically does allow for temporal analysis, *given sufficient projects per performance episode*[6]. The usage of performance episodes also suggests that it is of relevance that respondents within one project respond within the same performance episode. This was controlled for by (a) explicitly requesting to return questionnaires within a maximum timeframe after receipt and (b) an additional check of the returned questionnaires per project to see if they all reported being in the same performance episode (and potentially removing outliers).

[6] In hindsight: this turned out to be too ambitious - the number of responses per performance episode did, in the end, not allow for temporal analysis.

A third important question was that of multi-team systems and sub teams. To cater for the multidimensional aspect of the research, I needed to be able to identify which sub teams belong to which MTS and whether a sub team is part of a client or of a vendor organization. I therefore set up the questionnaires to be anonymous on a personal level but to allow for identification of the project and organization (either client or vendor) that the respondent works for. That is: I created sub team specific questionnaire booklets that specifically named the project and sub team (organization name) in the questions. As a side effect – this also allowed me to explicitly shift the reference point of questions where required.

Additional details on actual numbers and projects can be found in paragraph 3.3.

Variables were operationalized based on (a) existing scales where applicable and (b) scales designed specifically for this research where necessary. After the variables had been transformed into a questionnaire, a number of internal pilot runs were done to test the questionnaire for content, complexity, time-to-complete. In parallel, the initial list of literature was prioritized and added to, and focal areas reviewed in more depth.

Additional details on variables and operationalization can be found in paragraph 3.2.

I created a long list of propositions based on the outcomes of the literature review and adapted the questionnaire based on these propositions, the experiences with the pilot runs, and the additional literature based insights. At the same time, the search for potential projects took place; liaison representatives of client and vendor organizations were briefed and asked for their cooperation in handing out the questionnaires to their companies/project teams.

The research strategy is summarized below.

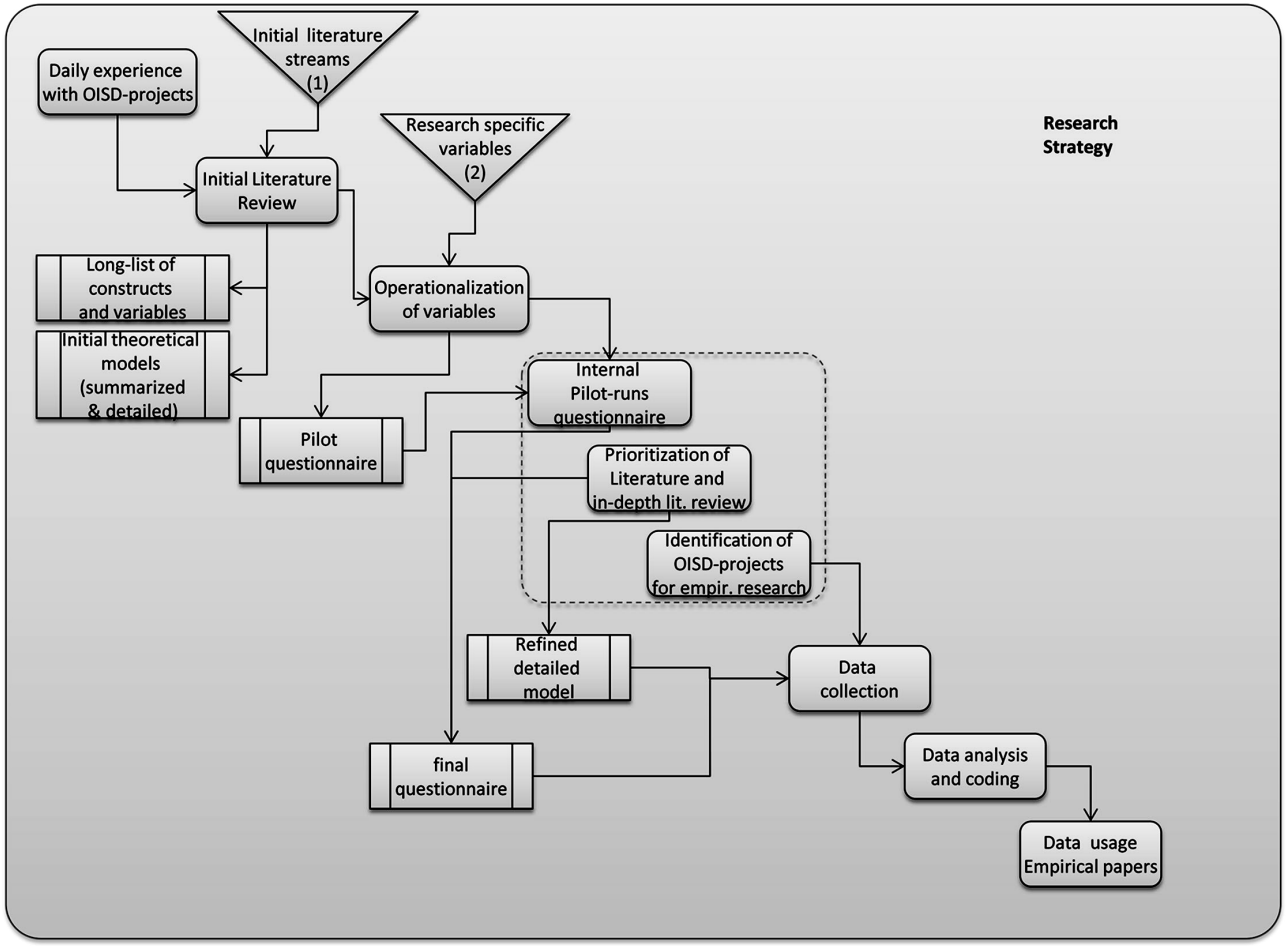

Figure 1 | Research strategy

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CHAPTER 2

Literature based conceptual framework

2.1 | Introduction – initial literature review

The team dynamics perspective is the focal point of this research and IS development and outsourcing provide the context. From this viewpoint, initial literature review was performed to provide context to be followed by more in-depth literature review on specific topics. That is: the literature review followed a hybrid two staged approach starting with an exploratory stage:

- Initial literature review of main relevant research streams aimed at providing a set of articles from these streams. Main purpose: identify relevant streams and literature; expand knowledge base for research.
- Prioritization of literature found and identification of specific topic-based complementary articles and literature.

An initial exploratory literature search was performed by searching the Outsourcing, IS development and Team related literature for (combinations of) the keywords: application development, application outsourcing, conflict, conflict management, distributed team, IS development, IT development, mental model, outsourcing, shared cognition, shared knowledge, shared mental model, shared model, software, software development, systems development, team cognition, team knowledge, team mental model, team model, transactive memory, virtual team. I searched both 'citations', 'abstract', 'title', 'document text'. During the research period, additional literature was added and reviewed based on specific needs and research angles.

The initial reading of outsourcing literature showed that this research stream does not focus on formal contractual issues only, it also reflects on topics like the psychological contract since outsourcing relationships are found to rely on both a formal as well as a psychological contract (Miranda & Kavan, 2005; Sabherwal 1999) that emerges between people (Ring & Van De Ven, 1994) as a result of interaction between those people. These initial findings supported the interest in my focal point of team dynamics and the potential role of shared knowledge and team cognition.

The team-related literature shows that much of the traditional research into teams – including IS development teams – is based on the IPO (Input-Process-Output) model as was formulated by McGrath (Kozlowski & Ilgen, 2006). Although this model most certainly has proven its worth, it reflects a fairly straightforward behavioral stimulus/response perspective in the sense that an input is supposed to lead to (the same) output through a process. In this sense, it does not credit the complexity that influences such a system in reality. Complexity as a result of both external influences such as changing conditions and as a result of the multi-directional interplay in teams. It has become clear that other factors that are more cognitive than behavioral in nature also play a role in team performance (Cooke et al., 2003). A strictly behavioral perspective does not for instance take into account that there is an inherent adversarial nature in the [outsourcing] contracts "*in that a dollar out of the customer's pocket is a dollar in the vendor's pocket*" (Willcocks et al., 2006). Beulen (2004) defines management of IT outsourcing as the activities that the outsourcing organization and the IT-vendor take to achieve governance. Lacity and Willcocks (2003) emphasize the need to embrace the

dynamics and development potential as the primary success factor of an outsourcing relationship (Jahner, 2007).

IS development literature discusses a large number of variables in the context of IS development success. Variables including affective components such as trust and commitment, cognitive components such as shared knowledge and (team) mental models and process components such as coordination and communication. Specifically in the context of IS development, the construct team cognition is used and its role in coordinating software development is discussed. This again supported my initial idea of focusing on the 'people side' of things, the team dynamics. Based on the initial literature review, I added a seemingly relevant research stream (and associated keywords) to my list: research related to Multi-Team Systems (MTSs) (Mathieu et al., 2001). Kozlowski and Ilgen (2006) conceptualize the team as embedded in a multilevel system and as dynamic systems that interact and that interpret and develop over time as a result of interaction.

Marks et al. (2001) state that: "*a problem with team process literature is the diversity of variables that have been selected as processes and the lack of distinction between process and emergent states"*. They suggest that emergent states are defined as properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes. Emergent states describe cognitive, motivational and affective states of teams. They can be considered both team inputs and proximal outcomes but are not processes in and of themselves because they do not describe the nature of interaction. Following this reasoning, in this thesis I make a clear distinction between *processes, dynamic states* (reflecting the cognitive dimension), and *emergent states* (reflecting the affective dimension). Kozlowski and Klein (2000) state that "*a phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon".*
The initial literature review led to the initial model that is depicted below:

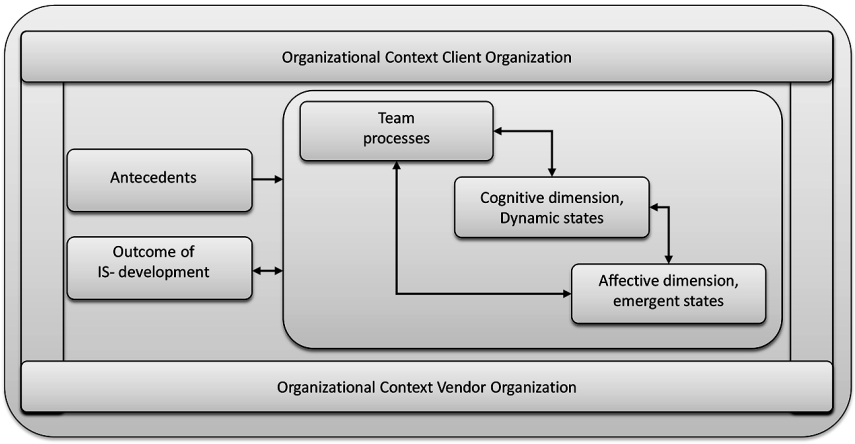

Figure 2 | Model of outsourced IS development project team dynamics

The key messages from this model are the concept of a Multi-team System (denoted by the two separate organizational contexts – client and vendor) and the dynamic interplay between process, cognition and affect. As a next step, a more in-depth analysis of the literature was performed with the aim to further detail the boxes in Figure 2 and to further operationalize the model with variables.

2.2 | IS-development: variables affecting outcome

A *project* in terms of the international ISO standard is defined as "*an endeavor with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements*" (Savolainen et al., 2011). When discussing the success of IS development, there are various potential outcome variables. A review of IS literature regarding success of Information Systems Development provided a list of relevant outcome components. Please refer to Appendix 9.2, Table 42, for a detailed overview. From the literature review, It is clear that on time, within budget, system quality, and meeting requirements receive virtually full support. Similarly, market standard project management methodologies discuss managing software development projects along three axes: time, money and quality. Additional analysis and combination of similar variables led me to follow the conceptualization proposed by Ryan and O'Connor(2013), Hoegl et al. (2004), and Faraj and Sproull (2000) in which team performance in software development is defined as a multidimensional construct: efficiency and effectiveness. Efficiency refers to the budget and schedule of the project whereas effectiveness refers to the achievement of project goals (Ryan & O'Connor, 2013). Similarly, in MTS research by Hoegl et al. (2004), team performance is defined as a multidimensional construct focusing on: quality (technical properties), adherence to budget (costs), and adherence to schedule (time).

Having established a conceptualization for outcome of MTS IS development projects, the next question is: what variables could influence these outcomes. Given the framework and context, I reviewed literature to find variables influencing (a) IS success directly (b) client/vendor relationship and outsourcing success (c) team effectiveness since such variables can be expected to influence the success of our outsourced, client-vendor IS development projects. The aim was to find relevant variables with sufficient support to further elaborate on the basic model (please refer to Figure 2) and to further detail the various boxes in that model (team processes, cognitive elements and emergent (affective) states).

Variables impacting IS development success

From the IS development context, I reviewed literature to find variables that were found to impact IS development success. Literature shows a long and varied list of variables. An overview is listed in Table 43 and Table 44 in Appendix 9.3. The conceptualization and operationalization of IS development success differs in various papers. In addition, some papers report direct relationships between the variables listed and outcome, whereas others report on indirect relationships. I therefore added an extra layer of analysis by mapping, based on literature, the independent variables such as listed

in Table 44 and Table 45 with the outcome variables listed in Table 43. The result can be found in Appendix 9.4.

Variables impacting IT-outsourcing

From the outsourcing context, I performed a similar search as for IS development: given the emphasis on team dynamics and client vendor relationships, this is the angle I reviewed in more detail in the outsourcing literature. To identify potential additional relevant variables, I did a similar review of Outsourcing literature regarding client-vendor relationship. Please refer to Table 48 in Appendix 9.5.

Variables impacting team effectiveness

The third angle is the team effectiveness perspective. After reviewing IS development and Outsourcing literature (highly specific to the context of this research), I reviewed team literature. In their comprehensive literature review on team effectiveness , Kozlowski and Ilgen (2006) state that there is over 50 years of psychological research focused on understanding and influencing the processes that underlie team effectiveness and that their goal is to sift through this voluminous literature. The table below reflects their findings and lists the behavioral, cognitive and affective elements that have been shown to affect team effectiveness in general and therefore can also be expected to be of relevance in the OISDP context.

Table 2 | Kozlowski and Ilgen (2006) summary of team effectiveness variables

Behavioral	Cognitive	Affective
Team coordination, cooperation and communication	Unit and team climate	Team cohesion
Team member competencies	Team mental models	Team efficacy and group potency
Team regulation, performance dynamics, and adaptation	Transactive memory	Team affect, mood and emotion
	Team learning	Team conflict

A challenge with team process literature is the diversity of variables that have been selected as processes and the lack of distinction between process and emergent states (Marks et al., 2001). Emergent states are defined as properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes. Emergent states describe cognitive, motivational and affective states of teams. They can be considered both team inputs and proximal outcomes but are not processes in and of themselves because they do not describe the nature of interaction. Emergent states can be considered a subset of dynamic states; the difference being that emergent states can only emerge and exists as a result of interaction whereas the broader group of dynamic states can have an independent existence (that is, could consist without interaction); both are dynamic and may change as a result of interaction.

Various categorizations of variables can be found: Goles and Chin (2004) provide a model that separates attributes (such as commitment and trust) from processes (such as communication and coordination). A more detailed model by Lee and Kim (1999) recognizes a behavioral dimension consisting of dynamic factors (such as coordination and information sharing), static factors (such as age of relationship and mutual dependency) and contextual factors (such as cultural similarity); a psychological dimension (elements such as trust, commitment); and outsourcing success (Fleming & Low, 2007; Sargent, 2006; Lee & Kim 2003, 1999). Findings from Lee and Kim (2003) show that that psychological variables mediate the relationship between three behavioral variables and outsourcing success.

Team research provides an even finer grained model. Combining these various perspectives, I conclude that it is of importance to distinguish between (a) behavioral, cognitive, and affective aspects and between (b) processes, dynamic states, and emergent states. From the main focal point of this research (the role of team cognition and shared knowledge), I performed a more detailed review of team literature centered on these topics. Similar to the previous analyses, I reviewed literature to identify cognition related variables and their impact on team performance in general or, more specifically, on IS development and outsourcing success.

Literature on team cognition related variables is abundant as can be seen in Table 49 in Appendix 9.6. As the tables show, a long list of (team-) cognition related variables exists – in some cases using different names for equal or very similar concepts. As an example: the terms team mental model and shared mental model are often used to refer to the same thing. A distinction that is made by Klimoski and Mohammed (1994) and later by Langan-Fox et al. (2001) suggests that shared mental model can be described as the extent to which a dyad of individuals possesses a similar cognitive representation of some situation or phenomenon whereas a team mental model refers to shared cognition in a team as a collectivity. For this research, I condensed the list of variables and created a mapping between the team cognition variables, outcome, process and affective dimensions following the initial model (please refer to Figure 2). The result can be found in paragraph 9.4, Table 46.

2.3 | Literature: Theoretical background

2.3.1 | Teams and coordination

When teams are a primary mechanism for accomplishing organizational work, effective coordination of teamwork becomes an important organizational issue (Faraj & Sproull 2000). Rico et al. (2008) states that models based on input/process/output relationship treat coordination as a key process for team effectiveness. And by others, coordination is seen as one of the most important aspects of teamwork and lies at the heart of effective team performance (Entin et al 2004). More generically, coordination is one of the most important aspects of teamwork (Bowers et al., 1997; Brannick & Prince, 1997). It means that team members adjust their own activities in response to the activities of other members and that where coordination is deficient, groups often fail (Peterson et al., 2000).

In order to manage dependencies, both explicit and implicit coordination mechanisms can and will be used by teams. Explicit coordination mechanisms include task programming mechanisms (e.g., schedules, plans, procedures, etc.) and communication (e.g., orally, in writing, formally, informally, interpersonally, in groups), whereas implicit coordination (i.e., without consciously trying to coordinate) takes place through team cognition, which is based on shared knowledge team members have about the task and about each other (Espinosa et al., 2002a). Other terminology but very similar concepts are used by Faraj and Sproull (2000) who discuss administrative and expertise coordination respectively. Well-coordinated teams will not necessarily be those that have strong team cognition or the best task programming or administrative coordination mechanisms, but those who find an effective mix of mechanisms for the coordination needs of the task they are engaged in (based on Espinosa et al., 2002a).

2.3.2 | IS development and team cognition

IS development requires knowledge and expertise from different domains since the work typically involves complex, dynamic, and unstructured tasks (He et al., 2007). The division of labor among teams and members is highly interdependent (Ryan & O'Connor, 2013). Developing software is teamwork and therefore requires an orchestration of efforts between various people with different skills. Division of labor and specialization introduce a need for coordination of work and activities; this is true within organizations and holds even more when discussing OISDPs since additional complexity is introduced as a result of the outsourcing - the development of the Information Systems becomes a task that is distributed over two component teams belonging to different organizations – a cross organizational MTS.

These component teams are interdependent toward the accomplishment of at least one distal goal (DeChurch & Zaccaro, 2010). To successfully reach this common goal (in essence: to deliver the right Information System, effectiveness), it is obviously critical that both component teams and their members work towards the same objective. This requires shared knowledge on this objective, that is: on the system to be built. On the other hand, the essence of outsourced IS development is having client and vendor work on their own, specialized, tasks (efficiency). This in turn requires that everyone does his/her own specialized task and that, when necessary, team members know where to go for answers or additional expertise.

On a daily basis, people from both the client and the vendor organizations will need to coordinate actions in order to achieve the objectives of the contract and to work towards achieving the required results of the OISDP. The more complex the task and the larger the team, the more dependencies exist and the greater the need for coordination of the various activities and dependencies. From a cost and efficiency perspective, both client and vendor typically strive towards a minimum of interaction, preferably artifact driven and based on clear-cut client/vendor interfaces allowing for clear communication, easy monitoring and control and minimum cost and effort. I will refer to this as a 'thin client/vendor interface'. Failing to achieve this objective may lead to projects characterized by extreme volumes of unplanned and ad hoc synchronization activities and interactions between

client and vendor that are characterized by high transaction and overhead costs and high levels of inefficiency. In the context of software development, ineffective management of the various complex interdependencies will lead to low productivity and substantial financial losses due to things like rework, missed deadlines, and priority conflicts (Espinosa, 2001).

IS development projects often fail because of coordination breakdown and insufficient knowledge exchange resulting from ineffective communication among team members (Hsu et al., 2012). Without team cognition, efficient sharing of knowledge, coordination and conflict resolution will not be possible (He et al., 2007; Cannon-Bowers & Salas, 2001; Hollingshead, 2001). Team cognition is a critical mechanism for facilitating knowledge activities in IS literature (He et al., 2007; Faraj & Sproull, 2000; Kraut & Streeter, 1995) and various theoretical reviews and empirical studies connect team cognition, taskwork and teamwork mental models to team outcomes and team effectiveness (Mohammed et al., 2010; Rafaeli et al., 2009; Lim & Klein, 2006; Mathieu et al., 2005; Rentsch & Klimoski, 2001; Mathieu et al., 2000). According to findings, "'*the effects appear to be particularly salient when team coordination and effectiveness are critical, which occurs primarily with complex or unpredictable tasks"* (Rafaeli et al., 2009). Levine et al. (1993) found that coordinated cognitive activity depends upon a shared understanding of what is being discussed or worked on. Ellis et al. (2003) concluded that even if information is shared, a team needs to have a common or shared frame of reference to properly interpret the information. The mere presence of individuals with diverse knowledge is an insufficient condition for a software project team to achieve quality performance (He et al. 2007; Faraj & Sproull, 2000). Team cognition plays an important role in that it "*allow(s) team members to draw on their own well-structured knowledge as a basis for selecting actions that are consistent and coordinated with those of their teammates*" (He et al., 2007; Mathieu et al, 2000). High quality teamwork and emergent shared knowledge structures are crucial for successful collective performance across different group development stages (Mohammed et al., 2010). The fact that the two sub teams in an OISDP MTS belong to different organizations – each with its own priorities, culture, ways or working - suggests that sharedness on the Multi Team level will always be constrained sharedness given these different contextual business environments.

2.3.3 | Processes

The role of communication

Literature on team communication argues strongly about the importance of communication for teamwork and coordination (Espinosa et al., 2006). Communication is one of the fundamental pillars of explicit coordination both in teamwork in general as well as in IS development and OISDPs in particular. Specifically for teams working on complex tasks, communication is found to be an effective coordination mechanism since it plays a critical role in coordinating efforts between people, teams and organizations. Ongoing communication is considered a necessity to clarify priorities, anticipate resource requirements, and report on issues and changes in project status. It is further found to reduce the possibility of misunderstandings and conflicts in IS development contexts (Kotlarsky, 2005). In IS development teams, especially face to face communication is an important mechanism "*since it allows us to build better working relationships with those people you cannot build over the*

telephone or via email. It allows us to get through more work in a short period of time" (Espinosa et al., 2006).

Especially in outsourced development contexts, not only effectiveness but also costs involved with communication are an important element. Transaction costs could even offset the financial benefits of outsourcing; hence controlling these costs is of relevance. Jarvenpaa and Mao (2008) consider 'designing cost effective communication and interaction patterns' as elements of client specific capabilities that IT vendors must establish in order to be successful. One such mechanism relies on shared knowledge and shared mental models since these are found to reduce the need for communication. These and similar findings suggest that shared mental models can help reduce (cost of) communication. On the other hand, shared mental models require communication and interaction to develop. For a team to act in concert to achieve common goals the team must have shared information about both he the situation and the other team members; team cognition thus requires communication (Entin et al., 2004). Evidence suggests that communication and interaction among team members is a primary cause of schema agreement (Rentsch & Klimoski, 2001) and that interaction (communication) is positively related to shared mental models to the extent that the more team members communicate, the more likely it is that they will form a common frame of reference and develop a shared mental model (Levesque et al., 2001; Klimoski & Mohammed, 1994).

Transactive memory is another mechanism found to increase performance in (IS development and other) teams. These transactive memory systems, directories of who knows what, are created through interpersonal communication – the strength of social ties determines how much tacit knowledge will be transferred (Peltokorpi, 2004). This brings us back to dilemma-1 that I presented in paragraph 1.1. The dilemma summarized as shared-as-in-common versus shared-as-distributed. Shared knowledge, shared mental models and transactive memory systems can alleviate the need for communication, they also need communication to develop.

The previously discussed findings relate communication to implicit coordination mechanisms such as shared mental models and transactive memory. Communication also plays an important role in explicit coordination. It does so both by itself, as an explicit coordination mechanism, and as a prerequisite for other forms of explicit coordination such as task-programming, which requires that team mates communicate to articulate their plans, actions, and responsibilities (Entin & Serfaty, 1999; Stout et al., 1999).

Interestingly enough, this type of formal communication requires a certain level of common knowledge to make sure that parties understand each other properly. Extremely detailed directions will need to be provided if such knowledge (for instance domain knowledge) does not exist at the vendor (Herbsleb et al., 2005). Once again, this again leads back to the interesting but complex situation that communication influences outcome directly, that it does so indirectly by allowing for shared knowledge and by acting as a prerequisite for task programming, which in turn requires shared knowledge. On the other hand: shared knowledge requires communication.

Besides the direct and indirect role that communication plays towards IS development success as discussed above, literature review also shows a clear relationship between communication and client-vendor relationships, which in turn influence IS development success. Both generically in inter-organizational relationships as well as more specifically in outsourcing relationships, communication is found to be an important determinant of success (Grover et al., 1996) and to be related to outsourcing partnership quality (Lee & Kim, 1999). This may be, in part, because realization of contractual elements (i.e., meeting requirements and achieving benefits) is dependent to a great extent on information exchange between the parties. The reviews show that the essence of these findings is that organizational relationships require information exchange – communication – and that this ongoing exchange of information also helps in avoiding conflict and achieving satisfaction (Willcocks & Kern 1998; Kern 1997). Furthermore, communication is found to lead to better informed parties, leading to more confidence and a willingness to keep the relationship alive (Goles & Chin, 2005; Dibbern et al., 2004; Lee & Kim, 1999; Grover et al. ,1996) and is found to influence trust, business understanding and commitment and thereby indirectly outsourcing success (Lee & Kim 1999). Interaction – as a prerequisite for trust and a relationship to develop – can be considered a necessity because inter-organizational relationships only emerge, evolve, grow, and dissolve over time as a consequence of individual activities (Ring & Van De Ven, 1994). Communication leads to greater trust and, contrastingly, greater trustworthiness can cause improved formal and informal communication levels (Gong et al., 2007; Dibbern et al., 2004; Kern, 1997; Dwyer et al. 1987).

The role of Task Programming (coordination)

In the context of software development, the crucial process of coordinating can be defined as the activities carried out by team members when managing dependencies (Espinosa et al., 2002a) specifically in three distinct areas: technical, temporal and process. In order to achieve (cost- and time-) efficiency in the process of software development, successful management of such dependencies is critical. Unplanned communication can be considered as the coordination technique of last resort (Herbsleb et al., 2005) and explicit coordination through task programming is one of the key mechanisms to avoid such unplanned communication and is reportedly the most relevant process variable related to IS development outcome success (Espinosa et al., 2006) before communication and shared knowledge and beliefs.

More specifically, task organization mechanisms are found to be negatively correlated to software development time (Bass, 2006; Herbsleb et al., 2005; Espinosa et al., 2002b) (hence: better task programming reduced software development time) and positively related to software development team efficiency (Faraj & Sproull, 2000). More generically (that is – not IS development specific), similar influences of explicit coordination and task programming are found to be positively related to team performance (Lim & Klein, 2006; Stewart, 2006; Cooke et al., 2003; Banks & Millward, 2000; Faraj & Sproull, 2000; Nidumolu, 1996; Kraut & Streeter, 1995).

Traditional organization theories focus on explicit coordination through task organization and communication. Such task organization mechanisms will generally be preferred for routine

aspects of the tasks, and for larger teams in which it is more difficult to communicate (Espinosa et al., 2006). In situations where the task process is relatively clear, a project manager can set up a detailed project plan (deliverables, tasks and activities, milestones) including a work breakdown and interfaces between sub teams or staff allowing for cost effective coordination and limited ad-hoc communication (Hoegl et al., 2003). For simple routine tasks, administrative coordination (the management of tangible and economic resource dependencies) is required to assign tasks, allocate resources, and integrate outputs (Faraj & Sproull, 2000).

Some of the task programming mechanisms are rigorous documentation, common processes, strict project controls and detailed project planning and common processes that help reduce communication by establishing protocols and clarifying issues related to processes and tools so that teams can channel their attention to more substantive issues and problems (Espinosa et al. 2006). The black box model, with clearly specified deliverables, is considered a potentially cost- and time-efficient approach. This model however, does require effort to make it work (Levesque & Wilson, 2001): Black box specifications work best for relatively simple, certain tasks that can be well specified (Levesque & Wilson, 2001), which typically is not the case in complex IS development projects especially with external vendors who do not have an implicit or experience based mental model of what the client expects and needs.

To identify additional relevant processes and affective elements, I leveraged the extensive analyses performed by Ilgen et al. (2005), Dibbern et al., (2004) and Marks et al. (2001). Marks et al. (2001) provide a framework and taxonomy of team processes. In this framework, they make a clear distinction between task work (*what it is that teams are doing*), and teamwork (*how they are doing it with each other*). Furthermore, they elaborate upon the distinction between processes and emergent states. Their taxonomy is based on literature review and follows a temporally based perspective and provides ten processes over three categories:

Table 3 | Marks et al. (2001) team processes

Taxonomy of Processes	
Mission analysis formulation and planning Goal specification Strategy formulation	This category is described by Marks et al. (2001) as 'periods of time when teams focus primarily on […] planning activities to guide their accomplishments of a team goal or objective'.
Action processes Monitoring progress Systems monitoring Team monitoring Coordination	Processes that most commonly during action phases (periods of time when teams conduct activities leading directly to goal accomplishment) (Marks et al., 2001, p. 366)
Interpersonal processes Conflict management Motivation and confidence building Affect management	Whereas Marks et al. (2001) do distinguish between processes and emergent states, they do not explicitly label the emergent states

Dibbern et al. (2004) provide an extensive survey and analysis of literature on information systems outsourcing in which they discuss stages of outsourcing including the 'how' stage where the relationship between client and vendor is discussed. Compared to the list above, they add communication as a critical process. In their literature review, Ilgen et al. (2005) examine research and theory relevant to teams. Their view of teams as complex systems with complex interplays between inputs, outputs, processes and emergent cognitive and affective states is adopted in this chapter. Compared to Marks et al. (2001), Ilgen et al. (2005) provide a more in-depth discussion regarding affective states. The authors provide various affective, behavioral and cognitive elements.

Table 4 | Ilgen et al. (2005) Team aspects

Affective	Behavioral	Cognitive
Trusting	Communication planning	Structuring
Potency, collective and group efficacy, team confidence, safety. Especially potency and efficacy may well be affective states related to Marks et al. (2001) process of 'motivation and confidence building' and can therefore be seen as a addition to the model. Like Ilgen et al. (2005), I will treat this group as one. I will use the label efficacy.	gathering information, Information sharing, seeking, developing strategy	Shared mental models Transactive memory
Bonding	Adapting	learning
Cohesiveness, Team viability, Social integration, Satisfaction, Team commitment	Performing, Helping and workload sharing	

Unfortunately, there is not always a clear distinction between affective state and process. Combining these findings, based on the review papers of Ilgen et al. (2005) and Marks et al. (2001) and making a clear distinction between processes and states, I created the following list:

Table 5 | Processes and affective states

Category	Element
Processes (behavioral)	Affect management; Communication; Conflict resolution; Conflict management; Coordination; Motivating and confidence building; Sharing strategy information
Emergent states (affective)	Cohesiveness; Commitment; Conflict; Efficacy; Satisfaction; Trust

Communication and coordination were discussed earlier in this paragraph.

Affect management

Affect management is listed by Marks et al. (2001) as one of the interpersonal processes. It is defined as "*regulating members' emotions including cohesion, frustration and excitement*"and can be considered a catch-all process to regulate the affective states.

Conflict resolution/conflict management is defined as "*The extent to which disagreements are replaced by agreement and consensus*" (Goles & Chin, 2005).

Motivation and confidence building is defined by Marks et al., 2001) as "*generating and preserving a sense of collective confidence, motivation, and task-based cohesion with regard to mission accomplishment.*" It can be expected to influence collective efficacy (part of shared beliefs in the table).

2.3.4 | Affect

Cohesiveness

The classic definition comes from Festinger, who defined it as "*the resultant forces that are acting on the members to stay in a group*"(p. 274). Cohesion denotes a state of social relationship among a team defined as "*the degree to which members of the group are attracted to each other*" (Ensley & Pearce, 2001). A formal contract between client and vendor will never be able to cover all contingencies (Beulen, 2002b) and is therefore not enough to manage the relationship. Structuring the contract properly is necessary but not sufficient for outsourcing success (Willcocks & Kern, 1998). Effective interaction between the parties at the cooperative level appears to be necessary as well for an outsourcing arrangement to succeed – this in turn requires personal bonds between individuals and cohesiveness within a team.

Efficacy & Potency

Collective efficacy refers to an individual's belief that a team can perform successfully, whereas group potency refers to a shared belief among team members that they can be effective as a team. Another difference that has been proposed is that of task specificity. Group potency relates to effectiveness across several tasks, whereas collective efficacy is task specific. Following Shanahan et al. (2007), the construct of collective efficacy bears much in common with the construct of group potency. For the purposes of this thesis, the constructs will be treated as synonymous.

Satisfaction

In the context of cross-organizational MTSs: *"A positive affective state resulting from the appraisal of all aspects of a firm's working relationship with another firm*" (Kern, 1997).

Trust

Where trust is linked to IS development in literature, it is considered important because it can reduce transaction costs (Espinosa et al., 2006), it facilitates information exchange (Espinosa et al., 2006) and is positively related to understanding between remote counterparts thereby increasing efficiency

of communications over distance (Kotlarsky, 2005). Trust lowers transaction costs of relationships because individuals engage less in self-protective actions (Espinosa et al., 2006) and the greater the ability to rely on trust, the lower the transaction costs (time and effort) required of parties to negotiate, reach agreements, and execute a cooperative IOR (inter organizational relationship, Ring & Van De Ven, 1994).

Another explanation of the role of trust is that it helps to prevent geographical distance from leading to psychological distance. This is supported by the notion of the formal and psychological contract (Sabherwal 1999, Ring & Van De Ven, 1994) that shows that it is the psychological contract that depends on trust.

Outsourcing relationships that combine the legal contract with mutual trust allow for a much stronger bond between the client and vendor parties (Lee & Kim, 2005; Sabherwal, 1999; Klepper, 1994). This psychological contract is comprised of two (sets of) elements: processes and social capital (Miranda & Kavan, 2005). Research suggests that once social capital (affect and cognition) is built, many benefits follow including increased efficiency, more cooperative behavior, less need for costly monitoring, in turn suggesting that the psychological contract and trust will be positively related to IS development success if only from an efficiency perspective. Trust is positively related to the psychological contract (Dibbern et al., 2004). Similarly, the model of virtuous (positive) and vicious (negative) cycles in outsourcing relationships (Sabherwal, 1999) shows that trust will lead to better performance as well as to an appropriate level of control whereas distrust leads to poor performance and over or under control.

The relationships above relate trust primarily to the efficiency of the IS development endeavor. There may also be effects on the effectiveness and quality. Trust is found to be positively related to the continuous exchange of information (i.e. communications) (Gong et al., 2007; Dibbern et al., 2004) because increased trust results in more willingness to share ideas and knowledge. In literature, trust is typically seen as influencing the client-vendor relationship in general, thereby by extension outsourcing success and outsourced IS development (as a special case of outsourcing). Trust is also found to be positively related to shared knowledge (Nelson & Cooprider, 1996) since increased trust leads to an increase in sharing of knowledge and by extension to an increase in shared knowledge. Shared knowledge was found to mediate the relationship between IS performance and trust (Nelson & Cooprider, 1996).

2.3.5 | Conflict

In general terms, conflict is defined as "*the experience between or among parties that their goals or interests are incompatible or in opposition.*" (Korsgaard et al., 2008). Conflict related research up until 1997 typically discussed two types of conflict: affective and substantive (Jehn, 1997) that reflected personal and task related conflict respectively. Jehn (1997) suggested that "*conflicts can just as easily occur about means as they can about the ends*" (Jehn, 1997, p. 530) and subsequently distinguished

three types of conflict that were adopted by conflict research: relationship conflict (RC), task conflict (TC) and process conflict (PC).

Relationship conflict:

- is defined as an awareness of interpersonal incompatibilities, includes affective components, and involves personal issues (Jehn & Mannix, 2001);
- entails interpersonal frictions and incompatibilities (De Wit et al., 2012; Jehn, 1997, 1995);
- involves interpersonal frictions (Behfar et al., 2011; Greer et al., 2008).

Task conflict:

- reflects awareness of differences in opinions pertaining to the team's task and does not – by definition – include intense interpersonal emotions (Jehn & Mannix, 2001);
- refers to disagreements related to the content and outcomes of the task (De Wit et al., 2012; Jehn, 1997, 1995);
- relates to disagreements about (collective) goals and task definition (Behfar et al., 2011; Greer et al., 2008).

Process conflict:

- is defined as an awareness of controversies about the how of task accomplishment including issues of responsibilities and who should do what (Jehn & Mannix, 2001);
- reflects disagreements about the logistics of task accomplishment and about how a group should go about completing a shared task (De Wit et al., 2012; Jehn, 1997, 1995);
- reflects disagreements over logistical issues, task distribution and scheduling (Behfar et al., 2011; Greer et al., 2008).

Ample research discusses the effects of the three types of conflict on team effectiveness, productivity, cohesiveness, commitment and team member satisfaction.

Relationship conflict

For relationship conflict, findings typically show that relationship conflict is detrimental to various indicators of team effectiveness (Behfar et al., 2011; Rau, 2005; DeDreu & VanVianen, 2001; Ensley & Pearce, 2001; Jehn & Chatman, 2000; Jehn, 1997, 1995). These findings were confirmed in two meta-analyses (de Wit et al., 2012; DeDreu & Weingart, 2003). The explanations provided suggest that relationship conflict (1) limits information processing because members spend time and energy focusing on each other rather than on the task (Greer et al., 2008; Simons & Peterson, 2000; Pelled, 1996), (2) limits group members' cognitive functioning by increasing their stress and anxiety levels because it often involves negative interpersonal behaviors including hostility, harsh language, threats and intimidation (Behfar et al., 2011; Yang & Mossholder, 2004; Simons & Peterson, 2000), and (3) leads to making negative interpersonal attributions for other team members' behaviors, which creates a cycle of conflict escalation (Greer et al., 2008; Simons & Peterson, 2000). What is clear is that relationship conflict negatively impacts team performance, suggesting that managing (reducing or preventing this type of conflict) is important, especially in client-vendor situations. It may lead to distrust of the accuracy of the information provided by other members or to unwillingness to depend on other's information. This will result in reduction in the usage of the awareness of the location of

expertise within the team – i.e. reduce the usage of the available transactive memory which means that performance can benefit less from the transactive memory system than in situations without conflict (Rau, 2005).

Task conflict

In previous research, task conflict also was referred to as cognitive conflict. The findings on the association between task conflict and team outcomes are less conclusive than is the case with relationship conflict and team outcomes. Task conflict has been hypothesized and found to benefit team performance (Ensley & Pearce, 2001; Jehn & Mannix, 2001; Jehn & Chatman, 2000, Jehn, 1995). Typical explanations are: (1) teams experiencing task conflict tend to make better decisions because of a better cognitive understanding of the issue being discussed and as a result of divergent thinking (Behfar et al., 2011; Greer et al., 2008; Peterson & Behfar, 2003; Simons & Peterson, 2000; Pelled, 1996), (2) task conflict would lead to better acceptance of decision since team members will feel that they were heard in discussing the issue at hand (Peterson & Behfar, 2003; Simons & Peterson, 2000), (3) task conflict may lead to greater team confidence and effectiveness (Yang & Mossholder, 2004; Alper et al. 1998), (4) task conflict may stimulate engagement and increase commitment to the task (Behfar et al., 2011; Greer et al., 2008).

On the other hand, task conflict was also found to be detrimental to team performance. Typical reasoning suggests that task conflict may distract members from the task at hand (Greer et al., 2008) and that its high association with relationship conflict may indirectly lead to degraded team performance (Greer et al., 2008; Simons & Peterson, 2000). Other findings supporting the negative relationship between task conflict and team performance were reported by de Wit et al. (2012), de Dreu and Weingart (2003), Jehn (1995). An important explanation can be found in the type of task being performed. In teams performing routine tasks, task conflict is detrimental to performance (Jehn, 1995) as a result of time loss for (unnecessary) discussions. Resolving or discussing task conflicts does take time and may distract from the actual task at hand (Gersick, 1989). In teams performing non-routine tasks or involving high levels of information processing, task conflict allows for the discussion of ideas, for building mutual knowledge and consequently, to better decisions and higher performance (Jehn, 1995); discussion is stimulated (Jehn, 1997); it may increase dialogue and acceptance of decisions and may help in the emergence of complex cognitive structures (Curşeu, 2006). The sharing of different interpretations of task content issues increases team learning and accurate assessments and teams use members' capabilities and knowledge better than in the absence of task conflict since discussion is stimulated (Jehn, 1997).
These beneficial effects in non-routine task groups may outweigh the potential negative effects of task conflict especially since lack of adequate knowledge can lead to poor decisions and products (Jehn, 1995).

Process conflict

Process conflict was defined as "*disagreements about assignments of duties and resources*" (Jehn, 1997, p. 540). According to Behfar et al. (2011), it represents how well groups are managing two important

types of coordination activities: decisions about how to manage the logistical accomplishment of the task and decisions about how to coordinate people in accomplishing the task. This includes assigning member responsibilities and deciding how to best use the group's time and resources.

Process conflict was not distinguished as a separate type of conflict until 1997 and has not been as widely researched as have been the other types of conflict (Greer et al., 2008). Findings so far show a fairly consistent negative impact on team performance (De Wit et al., 2012; Behfar et al., 2011; Goncalo, et al., 2010; Passos & Caetano, 2005; Jehn & Chatman, 2000). Jehn (1997) suggested that this negative impact is because task completion took longer when a team argued intensely about who should do what. Furthermore, members may become dissatisfied with the uncertainty and misdirect focus (Jehn & Mannix, 2001). De Wit and colleagues suggest that process conflict is the most detrimental type of intra group conflict for group performance (De Wit et al., 2012, p. 373). The negative impact on group outcomes of process conflict was also explained by suggesting that this type of conflict has connotations with personal worth and respect that are challenged in process issues and the personal connotations often carried by the issues at the heart of process conflicts, such as task delegation or role assignment (Greer et al., 2008) and therefore increase member emotionality and decrease members' focus on the task at hand (Greer et al., 2008) and will show a consistent negative effect on performance (Greer et al., 2008).
Other findings supporting the negative relationship between process conflict and team performance were reported by deWit et al. (2012), Behfar et al. (2011) Goncalo et al. (2010), Passos and Caetano(2005), Jehn and Chatman (2000), Jehn (1997).

However, process conflict was also hypothesized to benefit performance as it may lead to explicit agreements about how the group will work together to complete tasks in a timely manner. During the early phase, effective teams may also reach explicit agreements about how the group will work together to complete tasks in a timely manner. Developing such agreements may help clarify issues such as roles and responsibilities (Goncalo et al., 2010). Disagreements about who is responsible for what and how things should proceed might facilitate crucial reevaluations of processes, standards, and task and resource assignments, which may even improve group outcomes (Jehn & Mannix, 2001) and distal group outcomes, such as group performance (de Wit et al., 2012; Behfar et al., 2011). At the start of group projects, when the group is still in the preparation stage and can still benefit from the examination of different alternatives to complete the task, process conflict may be beneficial (deWit et al., 2012; Goncalo et al., 2010). In addition, small amounts of process conflict that were resolved efficiently, were found to facilitate performance (Jehn, 1997) for instance in situations where job assignments and responsibilities changed in the team. According to Befahr et al. (2011), "*when previous studies found a positive influence of process conflict on team performance, it was probably because process conflicts specifically prompted the team to be more deliberate about planning for how to use time and resources*."

Korsgaard et al. (2008) suggest that the concepts of process, relationship, and task conflict confound conflict as a consequence with its causes; in this thesis I distinguish between cause and consequence

(such as the need for shared knowledge and task conflict) aiming to help solve this issue – please refer to paragraph 6.3 for more details.

2.3.6 | Cognition

"(Future) research should develop strong conceptual definitions of cognitive terminology." (Mohammed et al., 2000) and it is important to look at the context and the content of the domain involved when discussing the conceptualization of shared mental models, or transactive memory, or any other shared understanding construct (Peterson et al., 2000). "*Talking about mental models can be a dangerous thing"* (Banks & Millward, 2000); the authors were referring to the confusion in terminology used) unless the constructs used are clearly defined and specific to the context in which they are used. This thesis supports the warnings of these authors and I suggest that both a theoretical model as well as empirical research into the role of team cognition in OISDPs does indeed require a cautious and context specific conceptualization of a team cognition construct. For this reason, I reviewed mental model and transactive memory literature in particular (and team cognition related literature in general) to create a context specific team cognition construct.

Team cognition has been studied in various shapes and forms (He et al., 2007; Mohammed & Dumville, 2001) including shared cognition, team mental models, transactive memory, shared mental models, and team knowledge but two cognitive structuring constructs have dominated literature on teams (Ilgen et al., 2005): the team or shared mental models construct (Espinosa et al., 2002b; Cannon-Bowers & Salas, 2001; Espinosa et al., 2001a; Levesque et al., 2001; Cooke et al., 2000; Stout et al, 1999; Klimoski & Mohammed, 1994) that emphasizes common cognitive elements among group members, and the transactive memory systems construct (Rau, 2005; Brandon & Hollingshead, 2004; Peltokorpi, 2004; Austin, 2003; Lewis, 2003; Sole & Edmondson, 2002; Hollingshead, 2001; Rulke & Rau, 2000; Liang et al.,1995) that emphasizes the unique and distinctive cognitive elements within a group and the extent to which meta-memory structures develop. One stream suggests that sharing of cognitive elements will benefit performance whereas the other stream suggests that specialization will benefit performance. Having a shared mental model suggests that sharing or overlapping cognitive elements benefits performance. The transactive memory system model suggests that specialization and an understanding of who knows what benefits performance. In essence, the two constructs reflect the two complementary meanings of shared: shared-as-in-common in the case of team mental models and shared-as-distributed in the case of transactive memory systems. A successful OISDP must take advantage of both these types to strike a balance between specialization (efficiency, economy of scale) and sharing-as-in-common (required for effectiveness). Sharing develops with the advancement of project phases and transactive memory systems emerge as a result of the socio-cognitive dynamics of the MTS. I refer back to paragraph 1.1 that introduces this fundamental dilemma.

The concept of both shared mental models and transactive memory systems as emergent structures follows previous research that typically distinguishes between two types of aggregation principles: composition and compilation (Mathieu & Chen, 2011; Kozlowski & Klein, 2000). Composition, based

on assumptions of isomorphism (statistics adequately represent the processes that associate lower level data with higher level constructs) and compilation, based on assumptions of discontinuity (where the higher level phenomenon is a complex combination of diverse lower level contributions) (Mathieu & Chen, 2011; Kozlowski & Klein, 2000). In their typology of emergence, Kozlowski and Klein (2000, p. 66, 67) position shared mental models in the composition category and transactive memory in the compilation category. This is similar to Kozlowski and Chao (2012) who discuss team knowledge in terms of team mental models (composition) and transactive memory (compilation).

Mental models

The term mental model has been used as an explanatory mechanism in a variety of disciplines over the years. Essentially, mental models are organized knowledge structures that allow individuals to interact with their environment (Mathieu et al, 2000). Most simply, it is possible to view such models as collections of declarative and procedural knowledge. Thus a shared model is shared knowledge (Klimoski & Mohammed, 1994). Blickensderfer defines shared mental models as "*the extent to which individual team members' mental models overlap – the extent to which team members share the same understanding of the task and the team*" (Brandon & Hollingshead, 2004). These or similar concepts are discussed in literature under various names such as group situation awareness, team schema similarity, inter-subjectivity, collective mind and transactive memory (Peterson et al., 2000). Espinosa (2001) also refers to various names for similar concepts including shared mental models (Kraiger et al., 1997; Klimoski et al., 1994), team situation awareness, transactive memory (Liang et al., 1995), group mind (Weick & Roberts, 1993), and shared cognition (Cannon-Bowers & Salas, 2001). These constructs are related but conceptually distinct (Peterson et al., 2000).

Team mental models (TMMs) are defined as "*team members' shared, organized understanding and mental representation of knowledge or beliefs about key elements of the team's relevant environment*" (Wildman et al., 2012; Mohammed et al., 2000, p. 125). TMMs are sometimes referred to as Shared Mental Models (SMMs). In their research on shared knowledge structures, Cannon-Bowers and Salas (2001) and Mohammed et al. (2000) argued that team members can share task specific knowledge, task related knowledge, and knowledge of teammates. In addition, Mohammed et al. (2010) argued that both task and team related knowledge structures guide information processing and performance. Wildman et al. (2012) provide a model in which they split team knowledge into four components: task related, team related, process related, and goal related knowledge (Wildman et al., 2012, p. 91). Hsu et al. (2011) distinguish between Task TMM and Team TMM: Task TMM suggests that team members hold a common schema regarding their tasks and the potential role that the broader environment and technology may play (Hsu et al., 2011); teamwork TMM represents a shared understanding among team members about how they will interact with one another – including full team interaction and teammate roles (Hsu et al., 2011). The distinction between two major content domains in literature is most common: (a) task related features of the situation such as understanding of task procedures, and knowledge of typical task strategies and (b) team related aspects of the situation such as knowledge of team member roles and responsibilities and knowledge of team mates' knowledge, skills, abilities, beliefs, preferences, style (Lim & Klein, 2006; Cooke et al., 2000;

Mathieu et al., 2000). The terms Shared knowledge and Mutual knowledge are both used. They are defined as knowledge that communicating parties share in common and know they share (Cramton, 2001). A similar concept is that of collective knowledge defined as the knowledge that is common to all members of an organization (Kotlarsky, 2005).

The concept of shared mental models has been used to explain team performance in various settings, including software development. Specifically, a positive relationship has been found between shared mental models of both task and team to software development success (Espinosa et al., 2002b). Team members use a common language to communicate explanations and expectations for a task, enabling better coordination of action, adaptive behavior, and facilitation of information processing (Lim & Klein, 2006; Banks & Millward, 2000; Kraiger & Wenzel, 1997). Also, shared mental models research has demonstrated that team members rely on shared knowledge structures to enhance coordination and that these models are directly related to team performance (Baker & Salas, 1997). Sharing information about goals, strategies, individual capabilities, and task priorities are important for helping individual members plan more effectively (Espinosa et al., 2006; Cooke et al., 2000; Mathieu et al., 2000; Klimoski & Mohammed, 1994).

Shared cognition

Shared Cognition is defined as (Cannon-Bowers & Salas, 2001):

- *Task specific knowledge:* the specific procedures, sequences, actions and strategies necessary to perform a task; task priorities; task contingencies.
- *Task related knowledge:* about task related processes, but not necessarily to a single task. It is not task specific; rather it holds across a variety of (albeit similar) tasks; team procedures.
- *Knowledge of teammates:* these perspectives argue that team members need to understand each other – their preferences, strengths, weaknesses, and tendencies in order to maximize performance. That is, knowledge of teammates is probably useful across a variety of tasks rather than a single task.
- *Attitudes/beliefs:* Examples include shared beliefs and cognitive consensus (Mohammed et al., 2000).

Cognitive consensus

Cognitive consensus is defined as similarity among group members regarding how key issues are defined and conceptualized (Mohammed & Dumville, 2001). It is also described as collective representations of issues and as the lens through which a group views matters of concern and is manifested in verbal descriptions of strategic issues (Mohammed & Dumville, 2001).

Shared beliefs

Shared beliefs are described as including things like common goals, shared vision about the project, thinking like 'one team' and a common understanding of processes and issues (adapted from Espinosa et al. 2006). Shared beliefs as well as cognitive consensus are seen as attitude/beliefs (Cannon-Bowers & Salas 2001, Mohammed et al., 2000). Shared beliefs are thought to influence

IS development indirectly primarily through client-vendor relationship aspects. Having a shared identity in a team fosters a belief that others will not act in an opportunistic fashion; this promotes expectations of cooperation and thereby encourages cooperative exchanges (Goles & Chin, 2005; Miranda & Kavan, 2005) and communication and information sharing (Goles & Chin, 2005). Shared identity, beliefs, expectations, and understandings are reported to influence the emergence of the psychological contract (Miranda & Kavan, 2005); a sense of purposes, values, or expectations for the cooperative organizational relationship that is identical among the parties is found to be required for cooperative inter-organizational relationships (Ring & Van De Ven, 1994). This importance is explained by their influence in informally regulating the relationship (Miranda & Kavan, 2005) by circumventing issues of bounded rationality in individuals' ability to acquire and process information. Shared goals need to be formulated in order to foster a collaborative relationship (cooperation) between the partners (Gewald & Helbig, 2006).

Discussion of 'shared as in common' concepts

The concept of shared mental models has been used to explain the performance of teams in a range of circumstances including software development teams. For instance in research by Espinosa, interviewees reported that shared mental models of task and of team are related to software development success (Espinosa et al., 2002b).

The primary benefit of shared mental models is presumed to be coordination (Cannon-Bowers & Salas 2001; Peterson et al., 2000; Baker & Salas, 1997; Kraiger & Wenzel, 1997). The fundamental reasoning related to the shared mental models approach is that overlap of individuals' mental models leads to greater shared expectations and explanations within a team which leads to improved coordination, communication and other team behaviors which in turn leads to superior team performance (Banks & Millward 2000). To the extent that group members have a shared understanding of each other's informational needs, task contingencies and response tendencies, they can coordinate their actions – coordination being an important aspect of successful teamwork (Lim & Klein, 2006; Mathieu et al., 2000; Bowers et al., 1997; Brannick & Prince, 1997). Shared knowledge about goals, strategies, individual capabilities, and task priorities are important because members have a shared understanding of the group's task and each other, which helps members plan their individual actions more effectively (Espinosa et al., 2006; Cooke et al., 2000; Mathieu et al., 2000; Klimoski & Mohammed, 1994) especially with IS project teams (Crowston & Kammerer, 1998).

Implicit coordination in IS development teams – based on shared knowledge team members have – is a coordination mechanism in IS development (Espinosa et al., 2002a) and as such acts as an alternative for explicit coordination mechanisms. Generically, highly similar mental models are suggested to support working toward common objectives and coordinating team members' actions, whereas differences in team mental models would likely result in greater process loss and ineffective team processes (Mathieu et al., 2000). Teams whose members structure and organize their team related knowledge in a similar fashion are likely to find it relatively easy to coordinate their activities (Lim & Klein, 2006). According to findings by Kotlarksy et al. (2008), achieving concerted action

(coordinated action) is more likely in the case of 'social cognition' since it improves interpersonal anticipation and adjustment. Similar findings relating shared knowledge to coordination are reported by Shanahan et al. (2007).

A lack of organized shared knowledge about the products being developed and the functions being implemented will lead to technical coordination problems (Espinosa et al., 2006). Similarly, coordination problems tend to appear when managers do not have organized shared knowledge about the established software process, which leads to confusion, duplication of work, and priority conflicts. In summary, having organized shared knowledge about key concepts, processes and products (i.e., shared mental models), helps teams coordinate (Espinosa, 2002).

In knowledge teams, members need to develop a common language for describing tasks, assignments, roles, and location of expertise (Faraj & Sproull, 2000). A 'common language' as an element of shared knowledge, is an enabler for interaction and communication (Fenema, 2002) since exchange requires conversion of tacit knowledge into explicit communicative actions, individuals need similar frames of reference to interpret these. If the team has no common language to discuss what needs to be done, the communication and thereby the effectiveness of the coordinative effort would be negatively impacted. Shared knowledge and shared mental models reduce the need for communication (Bass, 2006). Specifically in situations in which communication is impaired – such as in offsite IS development – shared knowledge can be valuable for coordination (Espinosa et al., 2006).

A collective understanding of the system under development is important since knowledge work depends on meaningful interactions amongst experts requiring knowledge of business context, applications, infrastructure, and project management (Kotlarksy et al., 2008). Shared knowledge is found to provide a common ground for effective communication with less complex messages and a common knowledge base that helps team members tap into expert knowledge sources within the team (Espinosa et al., 2006; Cramton, 2001; Nelson & Cooprider, 1996).

When shared knowledge occurs, a more complete understanding and appreciation of each other's reality grows. This is of critical importance in IS group performance (Nelson & Cooprider, 1996) since the need to operate from a common knowledge base begins in the requirements phase of systems development (Nelson & Cooprider, 1996), and continues through maintenance, support, and eventual deactivation or replacement of the technology (Nelson & Cooprider, 1996). Shared knowledge of both this process and the information technology in question supports and enhances the transfer of IT from vendor to client. Case based evidence (Crowston & Kammerer, 1998) showed that shared knowledge in a software development context led to situation in which it seemed that analysts just knew which features were needed, whom to ask for advice [...] and where the shared knowledge was an alternative coordination mechanism (alternative compared to traditional artifact driven coordination mechanisms). If there is relatively little domain knowledge at the vendor, then extremely detailed direction will need to be given in order to receive the required results (Herbsleb

et al., 2005). Therefore shared knowledge can be expected to positively influence efficiency of explicit coordination, that is, to influence the design of cost effective communication and interaction patterns (Jarvenpaa & Mao, 2008).

Empirical findings are not all clear regarding whether the influence of shared knowledge on outcome is a direct influence or an indirect influence through for instance team processes. However, even the findings that do not explicitly state a team process mediated relationship often offer explanations that imply such a mediating role. Furthermore, Mathieu et al. (2000) found that mental models had effects on team processes and that in turn, team processes were related significantly to team performance. The relationship of mental model sharedness was found to be fully mediated by team processes (Mathieu et al., 2000).

Transactive memory

Transactive memory is a concept that was introduced by Wegner. It refers to the idea that memory is a social phenomenon, and individuals in continuing relationships often utilize each other as external memory aids to supplement their own limited and unreliable memories (Mohammed & Dumville, 2001). The idea is that individuals can specialize and reduce their cognitive load by knowing where (with whom) to find the information or knowledge that they do not possess themselves (Mohammed & Dumville, 2001). Transactive memory emphasizes task oriented domains of expertise and is defined as (Austin, 2003):

- Knowledge stock (amount of knowledge).
- Consensus (agreement on who knows what).
- Knowledge specialization (amount of redundancy).
- Accuracy (correctness of knowledge about what others know).

Transactive memory is also defined as the set of knowledge possessed by the members of a team, combined with an awareness of who knows what (Rau, 2005; Faraj & Sproull, 2000). The authors suggests that teams with transactive memory can divide responsibility for storing and retrieving the information the team encounters among their members, either formally or informally, based on the members' areas of expertise (Rau 2005). Other definitions of Transactive memory system add information processing aspects such as cognitive system that teams use to encode, store, retrieve, and communicate information (Wildman et al., 2012, 2003; Brandon & Hollingshead, 2004; Lewis, 2003).

It is important to realize that transactive memory is based on a different principle than shared knowledge or beliefs; the latter are based on similarity and sharedness whereas transactive memory is based on the opposite: distributedness. It makes sense that in teams, of which division of labor is a key characteristic; both shared as well as distributedness (specialization being an example) are of relevance.

(Knowledge) specialization enables a group to make better use of its individual members because each group member can build a deeper knowledge base in a narrowly defined area of expertise.

Specialization may also enable transactive memory consensus and accuracy because it is easier to identify others' expertise in a group of specialists. Research on retrieval processes in transactive memory systems has shown that specialization can reduce repetition of effort and enable better access to a wide range of expertise (Austin, 2003). High-performing teams tend to be those with members who have accurate taskwork knowledge about their own roles and are dissimilar to each other in the structure of this knowledge, reflecting specialization (Levesque & Wilson, 2001).

Transactive memory systems are found to support team coordination (Espinosa et al., 2006; Rulke & Rau, 2000); correlates positively with efficiency and effectiveness in software development teams; shortens software development project life cycles (Kang et al., 2006; Kotlarsky, 2005) because of the time saved by knowing where to find required specialized expertise or knowledge (Kotlarksy et al., 2008; Faraj & Sproull, 2000) and by limiting the amount of information that must be shared (Kotlarksy et al., 2008). In summary, transactive memory positively influences group performance and collaboration because it fosters coordination (Espinosa et al., 2002a, 2001a; Faraj & Sproull, 2000) bringing needed expertise to knowledge seekers (Kotlarsky, 2005; Faraj & Sproull, 2000).

In this thesis, I will primarily follow the definitions as given by Cannon-Bower and Salas (2001). I will however use the label 'team cognition' as opposed to 'shared cognition' to reflect the construct in our context of OISDPs. I will do so because the term shared cognition is inherently ambiguous as a consequence of the ambiguity of the word shared.

2.3.7 | Attributes of team cognition: quality and sharedness

Complicating matters, besides the 'shared' debate, another – related – debate surfaced on the fact that measuring sharedness or similarity is not enough since accuracy is important as well. This from the consideration that team members can have very similar models and still all be completely wrong. I submit that the increased realization that accuracy is important is a logical consequence of the extension of the mental model concept with task related concepts since, when discussing task performance, it is immediately obvious that accuracy matters. For instance, Langan-Fox et al. (2001) state that "*The notion that similarity to a referent or expert mental model is associated with superior performance has been consistently supported in a number of domains*" and in claiming so, implicitly say that accuracy is important.

This is corroborated by findings that show that high performing teams tend to be those with members who have accurate task work knowledge about their own roles and are dissimilar to each other in the structure of this knowledge. This interesting profile of low intra-team similarity, coupled with high positional accuracy, reflects shared knowledge in terms of division of responsibility among the roles, as opposed to shared knowledge in terms of similarity or overlap (Levesque & Wilson 2001). Although findings show that mental model similarity and mental model accuracy are positively correlated, they are not redundant constructs or measures since both accurate as well as inaccurate models may be shared (Lim & Klein, 2006). Given the inherent different characteristics of shared mental models versus (distributed) transactive memory systems, the applicability of (combinations of) attributes needs to be discussed.

Shared Inaccurate

Literature shows different viewpoints on shared but inaccurate models. Yang et al. (2008) posit that inaccurate and poor mental models eventually disappear and will not be shared among team member. On the one hand, one might imagine a situation in which team members have very similar mental models and still all be completely wrong. A relevant question in the context of OISDPs (as well as in general), is what the yardstick is against which accuracy is measured and whether this yardstick is an internal or external one (relative to the group under scrutiny). In case of an internal yardstick, Yang et al.'s statement is likely to be true. Example: if the sub team of vendor representatives have a shared but inaccurate model of the software development method, this will likely be fixed since the group will be aware of the inaccuracy (the yardstick being internal). On the other hand, if the same sub team has a fully shared model on the information system that they will build but this model is inaccurate compared to the external yardstick (the client), then the inaccuracy may not be noticed until too late (i.e.: until the 'wrong' system is built).

Non-shared accurate

Another interesting combination is the non-shared but accurate category. At first glance, this category seems to make no sense – how can a group have an accurate mental model of something that is not shared? If it is the team mental model which is accurate – that is: the mental model on a team level – then by definition of it being the mental model on team level, is it not shared? Non-shared and accurate seem to be a *contradictio in terminis*. However, similar to the discussion above, this depends on the accuracy yardstick. Or, in this case, on the definition of the object or task that the model refers to. For example: in a car manufacturing plant, there will be different functional groups that may all have very accurate sub team mental models regarding their own part of the task; accurate models that may not be shared with the other sub teams. In essence then, non-shared and accurate does not reflect the shared mental model stream of research, it reflects the transactive memory (specialization) stream – it reflects distributedness of knowledge and models in sub teams as opposed to sharedness. Put differently: when one person in a group learns something that is not shared with other members of the group, this constitutes individual learning, not group learning (Wilson et al., 2007) and could result in a situation with accurate but non-shared knowledge on either individual or sub team level.

The 'shared accurate' and 'non-shared, non-accurate' categories are more self-explanatory. The discussion above shows that, in order to meaningfully discuss mental models and team cognition, and to provide meaningful and unambiguous propositions, it is important to clearly specify the team as well as the object that a mental model refers to.

Completeness is another relevant aspect with respect to shared knowledge. If the team in total does not possess the (complete) knowledge required to perform the task, the team cannot be successful. If a group is trying to solve a problem using only knowledge available within the group, then the knowledge stock of the group is an important determinant of group success (Austin, 2003). In summary, this leads to the following table that maps team cognition elements with quality and sharedness aspects:

Table 6 | Team cognition elements and attributes

Team cognition elements	Quality aspects of team cognition		Sharedness aspects (in common versus distributed)	
	Completeness	Accuracy	Similarity (sharedness)	Distributedness
Shared beliefs	-	-	Y	-
Shared knowledge	-	Y	Y	-
Transactive memory	Y	Y	Y	Y

Note: In the case of transactive memory: completeness reflects Austin's (2003) knowledge stock, accuracy reflects identification, similarity reflects consensus and distributedness reflects specialization.

2.4 | Conceptual Framework – theoretical model

2.4.1 | Conceptualization

Earlier in this thesis, the initial overall model was introduced – see Figure 2. In this chapter, I will provide a further conceptualization of the main boxes in that model (antecedents, team processes, cognitive dimension/dynamic states, affective dimension/emergent states, and outcome). Before that, I will present a more detailed description of *performance episodes* in an OISDP.

Outsourced IS development – projects and performance episodes

This research focuses on large IS development projects. The focus on the effects of team cognition aspects requires projects lengthy enough for shared knowledge to develop. I therefore define large in temporal terms as projects that last six months or more from the signing of the contract to the acceptance of the system. An OISD project as consists of multiple phases: a pre-contractual phase (vendor selection, tendering, negotiation etc.), a construction phase (the actual realization of the information system), and a use phase in which the system is actually used by the client.

This thesis focuses on the construction phase; that is the operational phase that starts when the contract is signed and client and vendor start working on the realization of the information system to be developed. This construction phase itself can be divided into various steps – the exact steps depend on the software development method chosen. The commonality – and point of interest in this chapter – is that responsibility typically moves from client to vendor back to client. A basic construction phase is depicted with design, build, and acceptance phases. Based on the primary responsibilities, the construction phase can be divided into three performance episodes as depicted below.

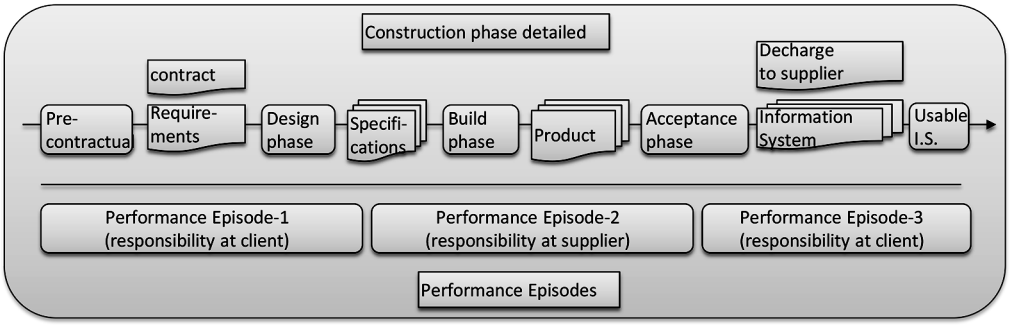

Figure 3 | Construction phase/performance episodes

Performance episode 2 (at a minimum containing the actual build phase) will take place under responsibility of the vendor. The episodes before and after this episode are the responsibility of the client. The abstraction is chosen to allow independence from the actual software development methodology whilst maintaining the essential elements: that of transfer of responsibility and need for cooperation.

Table 7 | Performance Episodes

Label	Start	End
Pre contractual phase	Business reasons for outsourcing	Contract signed with a vendor
Construction phase: performance episode 1	As soon as actual realization starts (typically with business requirements); responsibility for outcomes: at client	Demarcated by agreed upon deliverable (typically functional requirement or functional design) that will be used by the vendor as input for the technical realization of the IS.
Construction phase: performance episode 2	Agreed upon (by vendor) input allowing build phase; responsibility outcome: vendor	Software product that passed technical tests.
Construction phase: performance episode 3	Product delivered to client for acceptance; responsibility at client	Accepted (or rejected) information system product.
Use Phase	Accepted IS product	Usage of system at client organization

In more detail:

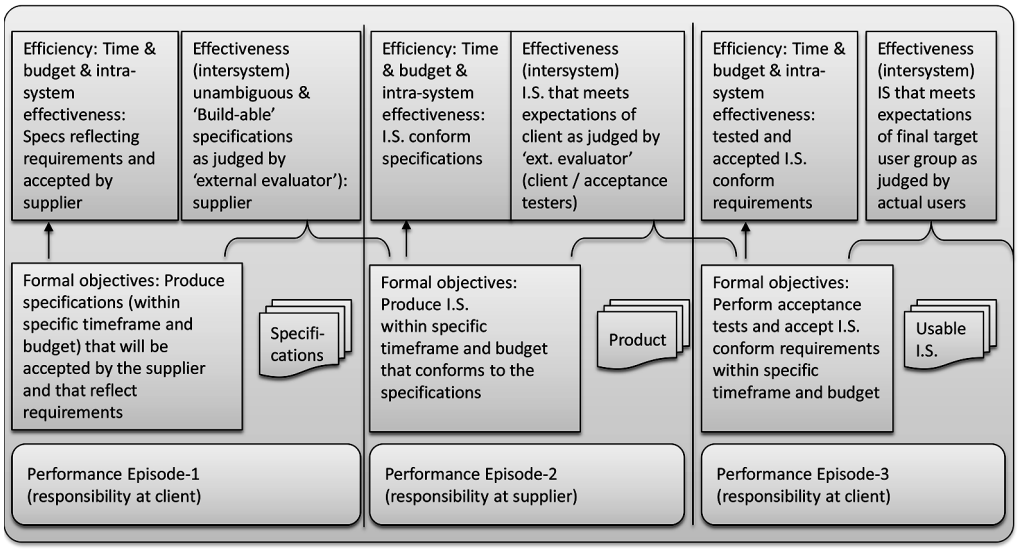

Figure 4 | Construction phase / performance episodes and objectives per episode

Conceptualizing outcome: Based on the literature review – paragraph 2.2 – outcome is conceptualized as a multidimensional construct consisting of an effectiveness component (quality) and an efficiency component (adherence to budget, adherence to schedule). This conceptualization of IS development outcome keeps the outcome construct pure and objective and immediately related to formal contractual agreements between client and vendor.

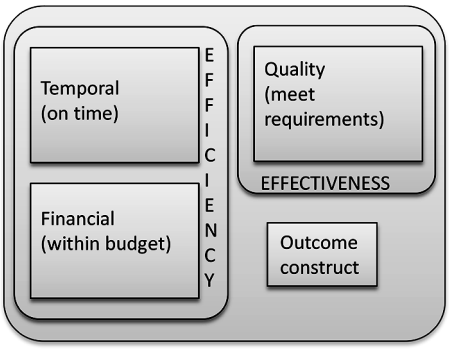

Figure 5 | Conceptualization of Outcome

Conceptualizing Processes: Similarly, based on the literature review – paragraph 2.2 and paragraph 2.3, I conceptualize the behavioral component as a set of processes. Following the distinction between dynamic (cognitive) and emergent (affective) states (and processes) as introduced in paragraph 2.1, the conceptualization of processes shows a number of processes that relate to the cognitive dynamic states (coordination, communication, sharing strategic information) and a number of processes related to the affective emergent states (conflict management, motivating and confidence building, and affect management).

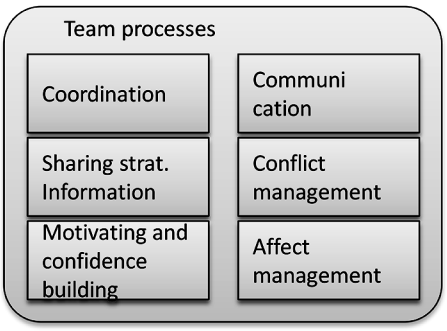

Figure 6 | Conceptualization of Team Processes

Conceptualizing Affective statues: Similarly, based on the literature review, the conceptualization of the emergent affective states is defined.

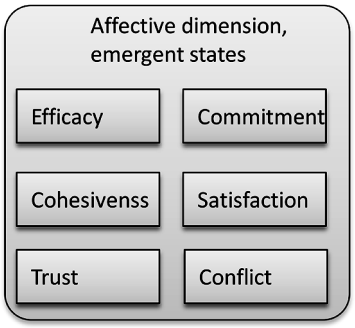

Figure 7 | Conceptualization of Affective states

2.4.2 | Team Cognition

A thought experiment

Conceptualizing team cognition is a more complex task given the specific context posed by the OISDP. Because team cognition is a focal point of this thesis and "*because agreement on the definition of a construct is a prerequisite to effectively testing ideas about it"* (Wilson et al., 2007), I open the black box on team cognition elements specific to the context of OISDP using a thought experiment to illustrate and highlight some key characteristics.

Assume a very simple, 2x2 jigsaw puzzle like the one depicted here, one assembly room, four separate working areas, and a team of four people spread over the four working areas. Each team member is supplied with a piece of cardboard the size of the complete jigsaw, a pair of scissors and other appropriate tools, a

sufficient supply of brushes and paint in appropriate colors. The task is to reproduce the pieces of the jigsaw puzzle using the material provided and to assemble a copy of the original jigsaw using the newly reproduced pieces. The requirements reflect the deliverable (an assembled copy of the jigsaw puzzle), time, resource, and quality constraints (faster, less material, better resemblance to original).
This simple hypothetical task highlights a number of important issues:

Completeness of the set of individual knowledge elements: For this team task to be completed at all, it is important that the team as a collective remembers all pieces of the jigsaw. If even one single piece is not memorized correctly (color, shape), the overall task cannot be completed successfully. This relates to the quality of the deliverable or the technical aspect of the team performance and is an aspect of the effectiveness of the team.

Accuracy of the individual knowledge elements: For the task to be completed successfully it is important that each individual piece is remembered correctly (accurately). This relates to the quality of the deliverable or the technical aspect of the team performance and is an aspect of the effectiveness of the team.

Introducing some additional complexity in the example, allows us to emphasize other aspects: We increase the jigsaw to 10x10 – that is, certainly too large for one individual to remember all individual pieces (which – for the sake of argument – are assumed to be of irregular shape to complicate the task) and we increase the team from 4 to 105 people; we assume that a group of five people is appointed to remain in the assembly room and are labeled 'coordinative team'; they are allowed to call in one team member at a time to add a piece (if a 'wrong' team member is called (wrong piece) a new one can be called in). The team is now faced with a more complex task and has many more options. This additional complexity does highlight some important points:

Specialization: Distributedness of the individual knowledge elements: Division of tasks is necessary both from an efficiency perspective as well as from an effectiveness perspective. The team can make various choices with respect to distributing the task. Distributedness of the knowledge elements reflects division of labor and, by implication, coordination of labor and dependencies. This relates to distributedness of knowledge and task specific models or, put differently (Austin 2003), specialization of expertise.

Sharedness of 'transactive memory': The coordinative group must, for each part to be added, decide who to call into the room. The coordinative team needs to decide which of the team members has the appropriate knowledge (the next piece). Since time is an important success criterion, efficiency in deciding who is next is important and agreement on who is next is important; lacking agreement, time will be wasted communicating and reaching a decision. This relates to sharedness of transactive memory or, put differently (Austin 2003), consensus about knowledge sources.

Accuracy of 'transactive memory'

Even with complete sharedness of transactive memory, the result could still be wrong. That is: the coordinative group may have full consensus on whom to call in with the next piece but call in the wrong person. This relates to accuracy of transactive memory or, put differently (Austin 2003), accuracy about knowledge sources.

Completeness of 'transactive memory': An incomplete transactive memory system would – even with completeness of knowledge stock (the 'right next team member' exists), high sharedness (coordinative team agrees that they do not know) and high accuracy of transactive memory (what is in the transactive memory system is correct) – still lead to inefficiency since it would imply that the 'right next team member' would not be identified.

Shared knowledge, Cognitive Consensus, Shared beliefs

If the coordinative team has no common language to discuss what needs to be done, the communication and thereby the effectiveness of the coordinative effort would be negatively impacted. A common language to discuss their approach, to discuss division of labor and objectives is required to be able to perform the task. Shared beliefs therefore includes things like common goals, shared vision about the project, thinking like one team and a common understanding of processes and issues (adapted from Espinosa et al. 2006)

The thought experiment above is inspired by Austin (2003).

Conceptualizing team cognition

I conceptualize team cognition as the emergent knowledge structures that are developed as a result of within-team and between-team interactions (Wildman et al., 2012; Klimoski & Mohammed, 1994), allowing us to see team cognition both as an input and as an output of team processes. Following the review of literature on team cognition and the thought experiment above, the following conceptualization of the cognitive dynamic state in the overall model is derived:

Transactive Memory

- Knowledge specialization: Due to the complexity of software development, specialization is a must. The additional specificity of the context of this research (outsourced software development) implies that there also is a form of specialization between provider (programming software) and customer (often: supplying requirements).
- Knowledge identification: knowing how to locate the appropriate knowledge.
- Knowledge stock: Related to the sum (Union) of the knowledge of the MTS and as such is an example of shared-as-in-distributed.

Shared beliefs

- Cognitive Consensus; Effective decision making without 'agreement on the conceptualization of important issues' (this is the definition of cognitive consensus) suggests a cumbersome and

inefficient cooperation. Willcocks and Kern (1998) in their case study on outsourcing find that misalignment of ambitions and expectations is often found to be the root cause of problems. To avoid such mishaps both parties need to develop mutual goals and/or objectives that guide the relationship.

– Team efficacy: The shared belief within the team that they can be effective. That is: a shared belief in the positive outcome of the OISDP.
– Vision and Identity: A shared vision on the (distal, super ordinate) goal of the OISDP.

Shared Knowledge

– Mutual Understanding: Shared language and terminology; shared knowledge on each other's drivers and issues.
– Goals and Objectives: Focused on more proximal goals and objectives; related to the task at hand.
– Tasks, processes and interaction: A shared model regarding the tasks, processes and interactions such as 'what does creating business requirements' mean, what output can be expected. Similar to interfaces between people and between client/vendor: who communicates what to whom?

In summary, this leads to the following conceptualization of the cognitive dimension:

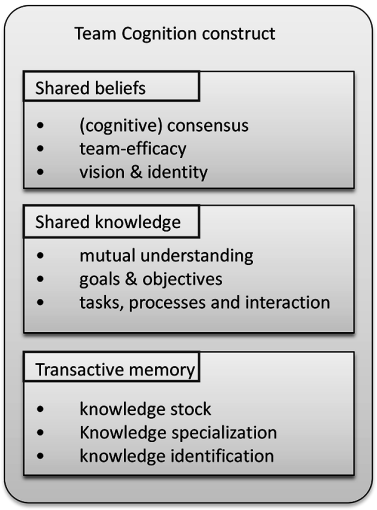

Figure 8 | Conceptualization of Cognitive dimension

2.4.3 | Theoretical model

Combining the 'boxes' above leads to the following overall, theoretical conceptual model of the complex interplay within the OISDP teams:

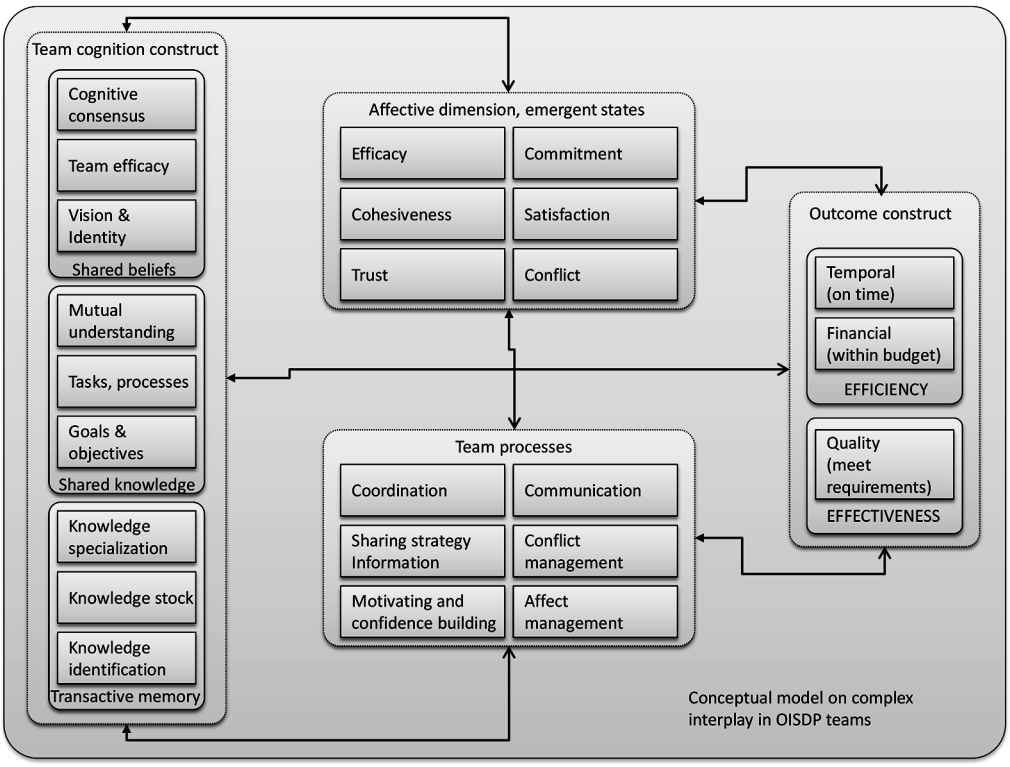

Figure 9 | Conceptualization of Dynamics in OISDP teams

The model shows bidirectional relationships. Please note that this figure does not show all detailed relationships that I found in existing literature and that were used to build propositions; it reflects the various constructs in detail and the relationships on an abstract level. This is because it is likely that there will be reciprocal influences operating between team processes, performance, and dynamic team characteristics such as mental models (Mathieu et al., 2005). This model is a theoretical model, derived from existing theory and findings. Clearly, operationalizing and empirically investigating all of the elements in this model in a single thesis will not be possible. Nevertheless I created the theoretical model to (a) provide a comprehensive overview of team dynamics based on existing findings and literature reviews, and (b) as a starting point for empirical research into parts of the model. Please note that the figure is an overview only; it is not intended to show each and every individual proposition that follows in the remainder of this chapter.

The figure reflects the relevant constructs, their components and, on the level of the multi dimensional constructs, it shows relationships that are described on a more detailed level in the propositions that follow.

2.5 | Team Cognition in OISDP Teams: A Multilevel Dynamic Model

This chapter has both theoretical and practical implications:

- Stages of team development: I define three task driven performance episodes specific to OISDPs and argue that the role of team processes and emergent states for team performance is contingent on these performance episodes. In doing so, this paragraph responds to the call for more dynamic models of team functioning and team performance (Ilgen et al., 2005).
- I distinguish between sharing and accuracy, and concur with existing research (Mohammed et al., 2010) that the impact of sharing on performance is beneficial. However, I posit that this beneficial effect is contingent on the accuracy of the shared knowledge.
- This paragraph provides practical insights for managing OISDPs by showing that shared task understanding, accuracy, and specialization are essential for OISDP effectiveness.
- Finally, I will provide a conceptual, multilevel framework that discusses multilevel team dynamics in relationship to component team and MTS performance.

Team cognition is dynamic (He et al., 2007; Klimoski & Mohammed, 1994). Whereas the prevailing wisdom is that members develop and share more understanding of one another's knowledge and skills as well as of the focal task as they work together (He et al., 2007; Liang et al., 1995) there are also studies that suggest that the understanding about the task and each other's expertise in a team may not become similar over time (He et al., 2007; Mathieu et al., 2000) or may even diverge at the end of the project (He et al., 2007; Levesque et al., 2001).

Starting from the conceptual model presented in the previous paragraph (see Figure 9), I will zoom in by discussing dynamics on both component team and multi-team system levels and focus on the role that shared knowledge – both shared as in common and shared as in distributed – plays. The multilevel model suggests the paradox that, in order to be successful, OISDPs must have specialized (distributed knowledge) component teams but they have to invest in the opposite (shared as in common) knowledge first. This because software development's craft character imposes the need for interactivity since the exchange of documents is generally insufficient for making the rationale behind a code transparent to others (Vlaar et al., 2008).

Thus, I first describe how the interplay between shared knowledge structures and specialization impacts the multilevel dynamic of the OISDP, and then develop a set of theoretical propositions and an integrative conceptual framework based on these relationships. The framework considers the relationships between variables at multiple levels of analysis. Most research suggests that higher level variables are more likely to influence lower level variables than the reverse (Mathieu

& Chen, 2011). Emergence as a multilevel process has received limited research attention in the micro–meso disciplines of organizational science (Kozlowski & Chao, 2012). Here, the focus is on emergent aspects such as shared knowledge in a context in which the upward influence is bound to be more prominent since the higher level phenomena (such as shared knowledge), has yet to fully crystallize (Mathieu & Chen, 2011). That is, as do Kozlowski and Chao (2012), I consider team knowledge development as emergent phenomena that will exhibit an upward influence.

2.5.1 | Team cognition: a dynamic, multilevel model of team cognition in OISDPs

Outsourced development of Information Systems involves the use of Multi-team Systems. The effectiveness of such MTSs depends on within as well as between team coordination and communication processes (Marks et al., 2005). MTSs are dynamic systems that interact, and then interpret, develop, and learn over time as a result of their interaction. Research into multi-team systems shows that failure of such MTSs often results from misalignment between the component teams; the subsystems were pulling against each other (DeChurch & Zaccaro, 2010). In short: the dynamics of Client/Vendor Multi-team IS development Systems are governed by a complex interplay of processes, cognitive and emotional aspects. The input/mediator/output model, discussed by Ilgen et al. (2005) and depicted in Figure 10 by Mathieu et al. (2008) provides a basis.

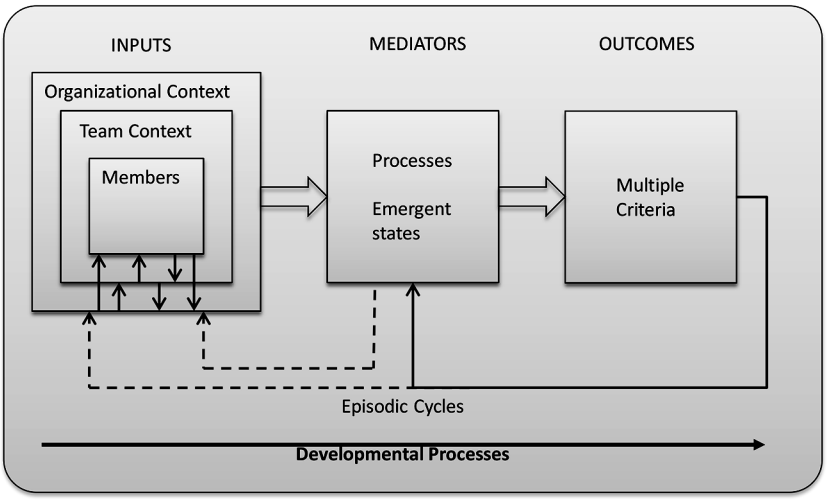

Figure 10 | IMO model from Mathieu et al., 2008

OISDP Multi-team Systems (MTSs) involve different levels of dynamics: personal, within component team (client or vendor sub teams) and cross component team, intra MTS. One of the potential issues with multilevel research is the unit problem (Mathieu & Chen, 2011), which refers to the fact that typically, lower level entities are members of more than just one higher level unit. The OISDP MTS, by virtue of it being a project team, is a temporary structure. Its component teams structurally belong

to their respective parent organizations and temporarily to the (project-) MTS. In this sense, the component teams are neatly nested (Mathieu & Chen, 2011). Another issue raised by Mathieu and Chen (2011) is the temporal issue related to the timing of measurement. Although this paragraph reflects a theoretical discussion – as opposed to an empirical one – it will act as the foundation for empirical research. In this research, I dealt with the temporal issue by focusing on projects with a minimum size and duration and by measuring in a short timeframe.

OISDP team performance

In a study on task interdependence in multi-team projects, Hoegl and Weinkauf (2005) divided the product development process into three phases labeled concept, development, and pre-production. I distinguish similar phases: a pre-contractual phase, a construction phase, and a use phase. In my thesis and research the focus is on the construction phase since this involves a significant level of interdependence between the two component teams.

Within the construction phase, again there is a distinction between three performance episodes, based on the prime responsibility per episode (client versus vendor). In paragraph 2.2, I discussed a conceptualization for outcome of MTS IS development projects – the multidimensional construct of *efficiency* (within budget, on time) and *quality* (technical properties, meeting requirements). In this thesis, I refine the quality criteria to take into account the specific context of cross organizational MTS. Because there is a shift of contractual responsibilities from client to vendor throughout the various performance episodes, I define quality *per performance episode*: the quality of deliverables by one component team will be judged by the other component team. A summary of OISDP MTS performance is presented in Table 8.

Table 8 | Summary of effectiveness and efficiency indicators in OISDP across performance episodes

Performance Episodes
For each performance episode, MTS efficiency refers to adherence to budget and to schedule.
Episode 1: Quality for E1 (which is the clients responsibility) is judged based on the output of E1 (requirements).
The deliverables of this performance episode are primarily evaluated by the vendor sub team. The deliverables must meet the following criteria: Are the requirements as produced by the client acceptable and accepted by the vendor as unambiguous and as of sufficient quality to act as the starting point for building the Information System?
Episode 2: Quality for E2 (which is the vendors responsibility) is judged based primarily by the client based on the deliverables produced by the vendor sub team (technically tested application or IS).
This episode is evaluated by the client sub team and must meet the following criteria: Is the quality of the IS that was built technically sufficient and is it ready for the client (end users) to accept for end user testing?
Episode 3: Quality for E3 is the final performance episode. The outcome of this phase is equal to the output of the entire IS development endeavor. Because of this, the output of E3 is technically and functionally tested before it is accepted as the approved IS.
This episode is judged by an external evaluator, rather than by the MTS.
That is: Will the system be accepted and will approval be given to the project team?
For the overall project
MTS efficiency is defined by adherence to the overall budget and schedule.
MTS quality is defined as overall quality and, as such, is identical to Episode 3 quality.

Episode 1 (E1) is the preparation phase and responsibility resides with the client. The client outlines the requirements that the vendor uses as input for the IS development process.
Episode 2 (E2) is the most critical episode. In this performance phase, it is the vendor's responsibility to build the actual information system; furthermore, it is this episode in which the expected cost and economy of scale benefits of the outsourcing endeavor will have to materialize. In this phase, the teams must efficiently exploit the information gathered in the first phase while spending their time mainly on technical tasks (Hoegl et al., 2004).
The prime responsibility for episode 3 (E3) is the client's. In this performance phase, the client tests the system that it has accepted from the vendor.

Team Cognition

This paragraph focuses on the role of team cognition in OISDP MTSs. In doing so, I follow the calls of other researchers to learn about "*how different team cognition constructs relate to one another in influencing team effectiveness"* (Wildman et al., 2012), "*to further examine the interrelations between different aspects of team knowledge"* (Mesmer-Magnus & deChurch, 2009), "*to see studies that defined shared knowledge in several ways"* (Cannon-Bowers & Salas, 2001), and to discuss conceptual frameworks and theories that feature multilevel influences. The focus is on shared task understanding, specialization and their interplay as influenced by: (1) the bi-dimensional evolution of OISDPs, and (2) the multilevel dynamics of the MTS. In addition, I offer an explanation for the convergence/ divergence dynamics of team cognition based on the lifecycle and performance episodes of a typical IS development team. Furthermore, the reasoning follows recent theorizing that focuses on temporal influences on team effectiveness (Bell & Marentette, 2011; Marks et al., 2001). Marks et al. (2001) discuss the concept of performance episodes and emergent states as dynamic team properties in these performance episodes. For teams to be – and remain – successful, the continued availability of needed knowledge but also an awareness of who knows what (transactive memory) is required (Bell & Marentette, 2011). To develop these ideas further, I integrate the complex dynamics of OISDP using two dimensions, a multilevel and a system development view. In the multilevel view the focus is on the two component teams and their interaction. In the system development view, it is on the component teams using the three performance episodes presented earlier. In both parts I apply the three stages model derived from Hoegl and Weinkauf (2005) that I introduced in paragraph 2.5.1.

In a 2009 meta-analysis (Mesmer-Magnus & deChurch, 2009), refer to uniqueness and openness in discussing information sharing in teams. Uniqueness refers to the extent to which teams are utilizing members' distinctive knowledge; they suggest that increasing uniqueness expands the pool of knowledge that is available to the team. Openness in their study refers to aspects of information exchange, team communication and overtly sharing information. Whereas openness does not necessarily increase the team's knowledge stock (Mesmer-Magnus & deChurch, 2009), the authors do expect it to benefit performance. He et al. (2007) discuss awareness of expertise location – a concept derived from the theory of transactive memory) and shared task understanding as two critical team cognition elements in the context of IS development teams. The distinctions made by

Mesmer-Magnus and deChurch (2009) on openness versus uniqueness and by He et al. (2007) on shared task understanding versus awareness of expertise location are similar to the distinction that I make in discussing shared mental models (shared as in common, openness) versus transactive memory systems (specialization, shared-as-distributed, uniqueness). In the conceptual framework, I add to their reasoning by suggesting that in the context of IS development, teams will need both forms of sharedness and that openness and shared task understanding necessarily must precede uniqueness for the multi-team system to be successful.

I synthesize Team Mental Models and Transactive memory in an OISDP MTS. Task related knowledge reflects knowledge about the information system to be developed (Shared Task Knowledge on the Information System or **SKIS**) while team related knowledge refers to knowledge about who knows what and knowledge regarding the client/vendor cross organizational interface (Shared Team Knowledge on the InterFace or **SKIF)**. SKIF focuses on Wildman's team and process related elements and is based on the transactive memory construct. It touches upon the consensus (agreement on who knows what) and accuracy (correctness of knowledge about what others know) aspects of Austin's (2003) definition of transactive memory. SKIF should help the MTS to create maximum knowledge specialization (Austin, 2003) (relevant from an efficiency perspective) and allow for sufficient (distributed) knowledge stock (Austin, 2003).

SKIF – ***Shared team Knowledge on the InterFace***

The division of labor between a client and a vendor is an inherent characteristic of an OISDP. Because of this division, a coordinated interface between the client and the vendor must exist, one through which information and joint processes can flow between and within component teams. Cross team coordination affects team performance (Hoegl et al., 2004), especially in those episodes – please refer to paragraph 2.4.1 for more details on performance episodes – in which there is a high degree of goal interdependence (Marks et al., 2005). Therefore, effective cross team coordination between the client and vendor, one that clearly specifies the component teams' responsibilities, is crucial (a concept related to Austin's (2003) *consensus* and *accuracy* components of the transactive memory construct). Effective interfaces of people and processes will positively influence an OISDP's efficiency, as it allows for *specialization* (Austin, 2003) by reducing the need for communication. That is: transactive memory allows for specialization that can reduce the repetition of effort, enabling better access to a wide range of expertise (Austin, 2003; Hollingshead, 2001), which is critical to support the underlying OISDP drivers of cost and specialization. In addition, it allows for sufficient *knowledge stock* by maximizing the usage of the union of the combined knowledge and skills. I introduce the concept of SKIF – based on the transactive memory construct – as an important enabling capability supporting effective MTS coordination.

Given the dynamic nature of IS development and the likelihood of running into unexpected issues, it is important that team members know where to find support and information. Social capital research refers to the importance of bridging (Han & Hovav, 2013) to improve team performance since this allows for accessing diverse required resources (Han & Hovav, 2013; Hansen, 1999). He et al. (2007) suggest that awareness of expertise location – derived from the theory of transactive memory – is

an important element of team cognition in software development teams (He et al., 2007, page 264), and pays a key integrative and coordinative function (He et al, 2007; Faraj & Sproull, 2000).
"*Transactive memory systems contribute to project team performance in two ways. First, TMS reduces the effort required for knowledge exchange and transfer by creating the knowledge map within the team. In addition by knowing the knowledge and expertise of each individual, members' behaviors can be anticipated. The consequence of this is alignment of actions among different people, enabling the team to function in a smoother manner. Second, collective tasks or problem solving requires complementary knowledge possessed by different team members. TMS enhances the team's ability to bring a greater amount of knowledge at group level to bear on ISD tasks when needed.*" (Hsu et al., 2012). Team members with a better understanding of how to interact should be able to effectively exchange and utilize the information collectively held by the group (Hsu et al., 2011).

From the perspective of knowledge sharing across organizational subunits, Hansen (1999) poses the question whether it is strong or weak relationships between people in different units that lead to efficient knowledge sharing among them (Hansen, 1999, p. 82). Users and IS developers both possess specialized knowledge that is needed for successful IS development (Tesch et. al., 2009). The same applies to the component teams in our client and vendor MTS. Although common and shared knowledge is important, I posit that this comes at a significant cost: project teams may expend considerable time and transfer efforts to be able to use the knowledge from other units (Hansen, 1999). I posit that for outsourced IS development a thin interface (weak ties) – is a necessity in order to reap the financial cost benefits given the cost involved in maintaining a strong tie, thick client/vendor interface and that SKIF is the mechanism that supports effective and efficient bridging in the context of outsourced IS development. SKIF is therefore a necessity for successful OISDP MTSs.

However, SKIF by itself is not sufficient. Without sufficient shared knowledge on the task and context (i.e. Shared Knowledge on the Information System to be built (SKIS)), the SKIF will be of limited use as shown by previous research on projects where knowledge required to complete a project is complex (as is the case in IS development projects) (Han & Hovav, 2013; Hansen, 1999). That is, I argue that strong ties will be required at the *start* of such projects in order to build sufficient shared knowledge. This is especially true in our context since outsourced IS development involves teams from different organizational and functional backgrounds. This leads us back to the paradox of outsourced projects depending on specialization and thin interfaces (knowledge shared-as-distributed) and the realization that in order to work through such a thin interface and to leverage specialization, the OISDP will have to invest in common (shared-as-in-common) knowledge first.

SKIS – Shared task Knowledge on the Information System

Specialization requires a certain level of common knowledge to make sure that parties understand each other properly (Herbsleb et al., 2005). There is ample evidence to be found in previous research showing the relevance of common or shared knowledge. Espinosa et al. (2002a) reported that division of labor is an effective task organization mechanism only at the end of the task, once team members know each other's skills well. That is: the component teams will need to invest in shared knowledge

before specialization can be successful. IS projects are characterized by high levels of uncertainty and constant change (Han & Hovav, 2013) and are therefore likely to meet unexpected challenges. In order to be able to efficiently deal with such challenges, a certain minimal level of mutual understanding and shared mental models are a prerequisite since such models allow individuals to explain relevant tasks and to deal with emerging issues effectively (Han & Hovav, 2013). Accurate interpretation requires a level of common knowledge and understanding about the system that is to be built. IS development is more cooperative and adaptive than individual work (Xiang et al., 2013) and requires team based effort that in turn requires collaboration and communication (Xiang et al., 2013; Faraj & Sproull, 2000). Research has shown that knowledge sharing among project team members is crucial for project performance (Han & Hovav, 2013). This is even more true for IS project teams since such teams are temporary organizations that may not progress through the necessary team formation cycle, consist of people from different functional backgrounds, yet are expected to produce outcomes in a limited time (Han & Hovav, 2013). In the outsourced IS development context, this issue is exacerbated even further due to different organizational backgrounds of the component teams.

Various researchers indicate that not only do IS developers need to have sufficient knowledge about the business to be able to build the required system, user knowledge of technical issues is important for success as well (Tesch et al., 2009; Nelson & Cooprider, 1996). Moreover, IS developers and users must work together to integrate their technical and application domain knowledge to achieve project success (Tesch et al., 2009). As Tesch et al. (2009), I expect that there will be a better chance for project success if IS developers and users have a common understanding about each other's domains. He et al. (2007) suggest that shared task understanding is a critical element of team cognition in IS development teams. People working on a software project need to develop a common view of relevant development issues such (He et al., 2007). Similar to Xiang et al. (2013), I consider Shared Mental Models of relevance to multi-team systems in IS development because such SMMs are required to support the cross functional integration of task and goals. As goals and a perception of tasks converge over time, and become shared, team members individual mental models become shared mental models (SMM) (Xiang et al., 2013; Yang et al., 2008). Such SMMs improves team performance and effective communication (Xiang et al., 2013; Cannon-Bowers & Salas, 2001). In summary: a certain level of SKIS is a necessity for success in OISDP MTSs. A summary of the shared knowledge in OISDPs is presented in Table 9.

Table 9 | Shared mental model elements in OISDPs

Shared Mental Model
Shared knowledge of the proposed information system (SKIS): Knowledge of the future users, goals, objectives, priorities, limitations, and risks of the system
Shared Knowledge of the Client/Vendor Interface (SKIF)
Knowledge of the joint OISDP interface processes by the client and vendor staff (contractual agreements, working processes and procedures, roles and responsibilities, information exchange, sources of information and expertise, dependencies between people and tasks in development process.

2.5.2 | Propositions

I have built my research into client/vendor IS development projects on the following model.

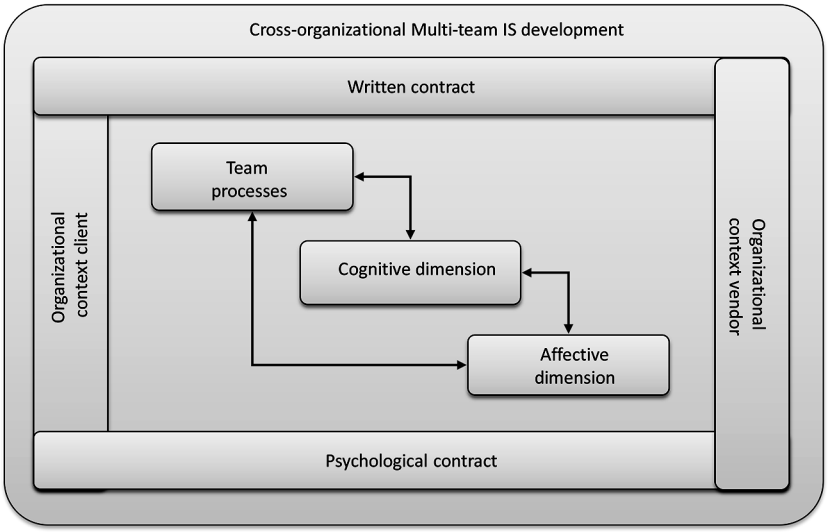

Figure 11| Summary model of interaction model

The (summary) interaction model in Figure 11 shows the multi dimensional constructs labeled team processes, cognitive dimension, and affective dimension that, based on existing theory and findings, can all be expected to play an important role in OISDP dynamics. As was discussed extensively in this and the previous chapter, Outsourced IS development, is a knowledge intensive task that, by virtue of it being outsourced, is driven by a need for specialization (either financially, from an expertise perspective, or both: please refer to paragraph 1.5). However, for specialization to work, a common knowledge base is required first (please refer to paragraph 2.5). This led to the introduction of the paradox that shared-as-in-common knowledge is a prerequisite for its counterpart, shared-as-distributed knowledge. It follows that there is a fundamental need to deal with this unavoidable team cognition paradox in OISDPs. In addition, from a managerial perspective, team cognition promises to be a relatively practical 'knob to turn' as compared to, for instance, the affective dimension (this is discussed in more detail in paragraph 8.5). It is clear from the literature and the model that team cognition alone is not enough. There are team processes and there will be conflict (it can even be expected that certain levels of task conflict and process conflict are a necessity to build sufficient shared knowledge!) Nevertheless, as the thought experiment (jigsaw, paragraph 2.4.2) showed, without complete, accurate, and shared knowledge, the task at hand (recreating the jigsaw, building the required information system) cannot be completed – irrespective of the quality of team processes and the level of conflict. These observations suggest that team cognition plays a pivotal role in the specific context of outsourced information systems development projects that are based on cross client/vendor MTSs. The propositions in this paragraph therefore focus on team cognition only.

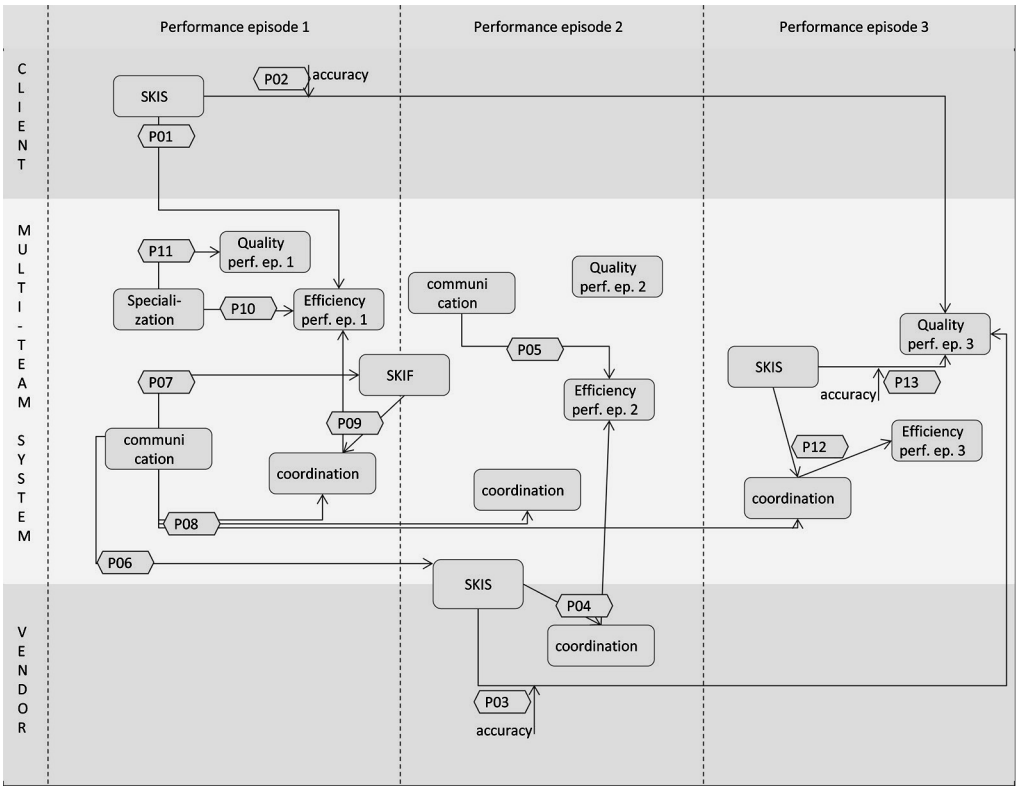

Figure 12 | Graphical overview of propositions

In performance episode 1, it is primarily the client sub team doing the work, resulting in requirements and specifications that are acceptable for the vendor sub team to work with. If, within the client team, there is insufficient shared (in common) knowledge on the IS that the client organization needs to have built, the definition of unambiguous agreed upon specifications to be delivered to the vendor team will become a difficult task. Insufficient shared knowledge of the Information System (SKIS) to be built, will lead to additional communication and discussion within the client team before agreement will be reached and a successful outcome can be attained (note that in this performance episode a successful outcome is an agreed upon, unambiguous set of specifications that the vendor team can use as basis for developing the actual Information System). Shared knowledge of the Information System (SKIS) within the client team – a common understanding and agreement of the requirements – facilitates clear specifications required as input for the build phase; specifications that are acceptable to the vendor. Therefore we can expect SKIS in the client team in episode 1 to have a positive effect on efficiency (time and budget).

Proposition 1: In episode 1, within the client team, SKIS will be positively related to efficiency (adherence to both schedule and budget).

In addition, it is intuitively obvious that *accurate* SKIS in the client *team* is a prerequisite for defining high-quality specifications that reflect the actual expectations that the client *organization* has from the system to be built. If the client project team has shared but inaccurate SKIS, they will provide the vendor with 'incorrect' specifications leading to the 'wrong' system to be built.

Proposition 2: In episode 1, within the client team, SKIS will be positively related to overall quality (of the system being built). This relationship is moderated by accuracy of the SKIS in the client team.

In Episode 2 the vendor team takes responsibility for actually producing - building - the information system. It is immediately clear that the vendor team cannot build the 'right' system (as defined by the expectations of the client's organization) if they do not have accurate and shared knowledge on the system to be built. In paragraph 2.3.6 , I discussed the important of team cognition for the quality of IS development. Specifically, a positive relationship has been found between shared mental models of both task and team to software development success (Espinosa et al., 2002b). Team members use a common language to communicate explanations and expectations for a task, enabling better coordination of action, adaptive behavior, and facilitation of information processing (Lim & Klein, 2006; Banks & Millward, 2000; Kraiger & Wenzel, 1997). As Nelson and Cooprider (1996) explained, in IS development the need to operate from a common knowledge base begins in the requirements phase of systems development and continues through maintenance, and support. Shared knowledge of both this process and the information technology in question supports and enhances the transfer of IT from vendor to client. In episode 2, quality is determined by how well the IS that was built actually meets the requirements. It is immediately clear that without sufficient understanding of the business requirements, IS developers will translate these requirements into software without the knowledge necessary to accurately interpret the requirements (Nelson & Cooprider, 1996). Even with clear specifications to guide the IS development, it is unfeasible to unambiguously define every contingency, so interpretation by the vendor sub team is inevitable. Common (shared) and accurate knowledge on the Information System to be built is a prerequisite for success. I introduced the construct labeled SKIS to describe this task-related shared knowledge on the IS in paragraph 2.5.1.

Proposition 3: In episode 2, within the vendor team, SKIS will be positively related to overall quality (as defined in Table 8). This relationship is moderated by accuracy of the SKIS in the vendor team.

Also, shared mental model research has demonstrated that team members rely on shared knowledge structures to enhance coordination and that these models are directly related to team performance (Baker & Salas, 1997). Sharing information about goals, strategies, individual capabilities, and task priorities are important for helping individual members plan more effectively (Espinosa et al., 2006; Cooke et al., 2000; Mathieu et al., 2000; Klimoski & Mohammed, 1994). In episode 2, as with episode 1,

SKIS is likely to facilitate adherence to schedule and to budget through more efficient coordination albeit that in episode 2 the benefits are to be expected primarily in the vendor team.

Proposition 4: In episode 2, within the vendor team SKIS will be positively related to adherence to schedule and budget, mediated by team coordination.

In paragraph 2.5.1 Episode 2 is described. This episode is characterized by high levels of specialization, by the vendor team doing what it is paid to do: develop software. This episode is where the main drivers of OISDPs must materialize (cost savings and access to specialized knowledge). This means that in this episode, the vendor's team is more or less 'on its own' and that (expensive) personal communication preferably is replaced by formal, artifact driven communication. Personal and ad hoc communication takes time and is expensive – in episode 2 the pressure towards efficiency and a thin, artifact driven interface increases. It can even be expected that communication on the MTS level is negatively related to efficiency (adherence to cost and budget)

Proposition 5: In episode 2, MTS-level cross team communication will be negatively related to efficiency.

On the other hand, in proposition 3 the importance of SKIS in the vendor team is discussed. Shared knowledge and shared mental models provide a common ground for effective communication with less complex messages and a common knowledge base that helps team members tap into expert knowledge sources within the team (Espinosa et al., 2006; Cramton, 2001; Nelson & Cooprider, 1996). The development of accurate SKIS by the vendor team requires learning and interaction with the client team since they are the source of this information. A paradox can be found in the necessity for SKIS in the vendor team versus the learning inhibiting and specialization focused characteristics of episode 2. It follows that the required vendor sub team SKIS must be built up in episode 1, in turn suggesting that sufficient communication and sharing of knowledge between the two teams must take place in episode 1. With this communication, sharedness of knowledge will grow in both sub teams and in the MTS as a whole.

Proposition 6: Cross team communication (communication on the MTS level) in episode 1 will be positively related to SKIS in the vendor team and to SKIS in the MTS as a whole in episode 2.

Cross team communication in episode 1 will also allow team members to learn who knows what and who is responsible for what as well as enable discussions on interface processes. The artifact driven interface and formalized communication procedures required for episode 2, will have to be established in episode 1. As with the development of SKIS, building up this teamwork related knowledge (SKIF) requires communication.

Proposition 7: Cross team communication (communication on the MTS level) in episode 1 will be positively related to Shared Knowledge on the InterFace (SKIF).

Through its effects on SKIF and SKIS, as well as a direct effect, it can also be expected that communication in the early project stages (episode 1) is beneficial to coordination in the MTS in subsequent phases. As discussed in paragraph 2.3.3, communication is related to implicit coordination mechanisms such as transactive memory and to explicit coordination.

Proposition 8: Cross team communication (communication on the MTS level) in episode 1 will be positively related to cross team coordination (coordination on the MTS level) in all episodes.

Geographically separated team members lack mutual knowledge of each others' situations, prompting misunderstandings (Sole & Edmondson, 2002; Cramton, 2001). A team's collective knowledge is more likely to be effectively applied when members are familiar with the ongoing practices at the sites across which the team is dispersed (Sole & Edmondson, 2002) and familiarity enables mutual understanding and allows members to recognize the extent of potential knowledge gaps (Sole & Edmondson, 2002). The same reasoning applies to the client and vendor sub teams in OISDPs that are not located in the same place. Both shared knowledge of the client/vendor interface and knowledge of processes that lie just behind the interface allow for better understanding and alignment of processes, for increased understanding, for identifying knowledge gaps, and for better coordination. Therefore, SKIF is expected to influence the adherence to schedule in the MTS.

Proposition 9: In episode 1, MTS Shared Knowledge of the client/vendor interface (SKIF) will be positively related to adherence to schedule, mediated by client/vendor cross team coordination.

In the initial episode of OISDP construction, client and vendor component teams work together for the first time. Whereas the work is primarily the client team's responsibility during this episode, different forms of participation from the vendor sub team can be considered; ranging from 'no cooperation' (the vendor sub team just waits until acceptable requirements and specifications are handed over) to 'co-creation' in which case there is a much stronger tie between the two sub teams. As we discussed earlier in this paragraph contact, interaction, and communication are required to reach a mutual understanding of the task at hand.

As discussed in paragraph 2.3.2, both client and vendor are pushed to work towards a thin and artifact driven client/vendor interface since specialization is a key success factor to reap the expected financial benefits of OISDPs. However, in this stage of an OISD project, specialization on the multi-team system level can be expected to constitute a barrier inhibiting the development of shared knowledge; specialization will hamper interaction, as OISDP members face a higher knowledge exchange threshold; as a consequence they need more time to understand each other suggesting that in this phase, specialization will be negatively related to efficiency (adherence to schedule).

Proposition 10: In episode 1, specialization on the MTS level will be negatively related to the adherence to the established schedule.

In addition, less productive interaction in terms of generating shared knowledge can lead to insufficient understanding at the sub team level; knowledge that is necessary to produce high quality requirements. This, in turn, potentially hampers knowledge development at the vendor team level, as they would have inadequate input to develop the technical specifications needed to design and build the appropriate information system.

Proposition 11: In episode 1, specialization on the MTS level will be negatively related to the overall quality of the outcome.

Episode 3 is characterized by higher levels of cross team interaction. Typically, acceptance testing and quick fixes for serious issues will be performed almost in parallel. Although the prime responsibility for this phase is the client's, the vendor plays an important role as well. Interdependence is high. The shared knowledge of the IS across the entire client/vendor team, as well as a cross understanding of the interface, plays an important role. In episode 3, SKIS influences efficiency because a lack of shared knowledge leads to an increase in expensive communication. In this episode, efficiency is determined largely by cross team coordination. Thus, shared knowledge on the IS across teams will minimize complex debates and increase the efficiency of coordination.

Proposition 12: In episode 3, shared, cross team knowledge of the IS will be positively related to adherence to both schedule and budget mediated by the cross team coordination processes.

In episode 3, quality is determined by the external yardstick of the IS being built and tested to meet the expectations and requirements of the users. This suggests both the sharing of the knowledge of the IS by the entire team and the accuracy of this knowledge as measured against the real users' expectations, are crucially important. SKIS influences effectiveness positively because the client staff can test the system's most important aspects supported by knowledge of the workings of the system. SKIS also enables the vendor staff to successfully fix problems because of their knowledge of the underlying objectives. In episode 3, the relationship between SKIS and quality will be moderated by the accuracy of the shared knowledge.

Proposition 13: In episode 3, shared cross team knowledge of the IS within the entire team will be positively related to quality moderated by accuracy of this shared knowledge.

Conclusions and Implications

I discussed the pivotal role of team cognition in the specific context of outsourced information systems development projects that are based on cross client/vendor MTSs. This context allows for multilevel research into the temporal dynamics of MTS, component teams and individuals. In doing this, I incorporated research in a variety of areas into one integrated perspective of OISDPs. In the process, context specific team cognition elements were defined and the ways in which they relate to quality and efficiency explored, using a multilevel perspective. This conceptual analysis suggests that in consecutive IS performance episodes with increasing levels of interdependence,

both efficiency and quality are likely to benefit from increasing shared knowledge, but suffer from specialization. In performance episodes that do not require members to work interdependently, both efficiency and quality can be expected to benefit from specialization; however, the effect on quality is contingent on accurate shared knowledge.

Managerial implications

The development of team cognition in OISDP MTSs reflects team learning. Groups of client and vendor staff in OISDPs start a project knowing 'nothing'. They come from separate organizations with different contexts and are motivated by cost efficiency to limit expensive communication and interaction whereas at the same time, they need to be working together to achieve a common goal. Team cognition is an important enabling factor. The degree to which developing team cognition and shared knowledge succeeds, varies. For instance, teaching teams about each other's responsibilities and tasks (cross training) had a greater effect on performance when role specific task work knowledge had been trained and was followed by cross training in teamwork knowledge (Cooke et al., 2003) suggesting that in order to develop teamwork knowledge, task experience must be taught first. This supposition reinforces the propositions in episode 1 that high specialization will have a negative influence on team cognition. Later research confirms this; Cooke et al. (2004) suggested that team members need to understand what is done and what needs to be done before they understand who does it. This implies that deliberate team learning needs to be carefully planned and that shared task related knowledge, such as processes and procedures, is required before transactive cross understanding on the interface can develop.

Based on the characteristics of the OISDP, team cognition elements will develop over time and across different performance episodes. For instance, in episode 1, both sharing and accuracy of the shared knowledge elements can be expected to increase since this episode inevitably involves client/vendor interaction. However, the drive towards a thin interface between vendor and client will act as a counterforce to the necessary build-up of shared knowledge. This dilemma between the need for sharing versus a thin artifact driven interface, suggests that additional conscious efforts to strengthen accurate shared knowledge in episode 1 may be required and will result in more efficiency and higher quality both in this as in later performance episodes.

In episode 2, specialization tends to increase, supporting the underlying premise of the outsourcing endeavor. Whereas this specialization in itself can be beneficial, care has to be taken that the shared knowledge that is required to make 'specialization work' is not lost. In episode 3, due to increased interaction between the client and the vendor, an increase in accuracy and sharing of knowledge takes place. The outcomes in episodes 1, 2 and 3 have important implications for managers of OISDPs. In performance episode 1, there should be more emphasis on and investment in interaction and sharing knowledge to increasing the sharedness and accuracy of knowledge of the information system, as well as of SKIF. Furthermore, the tendency to emphasize specialization should be controlled, since it will produce negative effects. Investing in shared knowledge should be carefully planned, not substituted for task oriented cross training (Cooke et al., 2004). Because

episode 2 is characterized by specialization, the sharedness of the knowledge stock will not grow. This loss of sharing is risky since it may lead to erroneous decisions. Although deliberate investments in the increase of shared knowledge may negatively affect efficiency in episode 2, unless sufficient shared knowledge capital was built up in episode 1, quality may suffer. Episode 3 relies more heavily on shared knowledge than episodes 1 and 2. As a result of increased interaction in this episode, accuracy and shared knowledge are likely to increase. Therefore, a deliberate effort to increase shared knowledge may be unnecessary and, compared to episode 1, maybe difficult to achieve, since prior learning and existing group mental models can interfere with new learning (Wilson et al., 2007). If the decrease of sharing in episode 2 led to divergent models, this might pose a problem.

Theoretical contributions and future research directions

This conceptual chapter highlights the need to address the role of shared mental models in a dynamic perspective. The propositions I advance suggest that the role of shared knowledge on team performance depends on the degree of interdependence in three distinct performance episodes. The propositions extend previous research on shared mental models and task interdependence by showing that the degree of task interdependence varies across performance episodes, and thus, the beneficial role of shared mental models is expected to occur only for the episodes that involve high task interdependence. Some questions to be addressed by future research include: (1) At what point in team development should members focus on sharing information? (2) How do shared mental models developed in one performance episode transfer to other performance episodes? Answers to these questions would help researchers to better understand the interplay between shared mental models and team development stages.

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CHAPTER 3

Reflections on Research, Methods, and Measures

3.1 | Reflections on key concepts and empirical research

In the early stages of this research, my primary focus was on (shared) knowledge from the (experienced-based) notion that 'mutual understanding' – in a broad and at that moment undefined sense – seemed to be a lever to help move outsourced IS-development projects forward. This, as described in chapter 2, led to the initial model that can be found in Figure 2 Model of outsourced IS development project team dynamics that shows the dynamic interplay between *team processes*, a *cognitive dimension*, and an *affective dimension*. The review of theoretical and empirical literature, led to a much more elaborate model in which these three rather abstract concepts of processes, cognition, and affect are defined in more detailed terms based on findings reported upon in literature. The result is shown in Figure 9 Conceptualization of Dynamics in OISDP teams. The figure reflects the various constructs in detail and the relationships on an abstract level. It is immediately clear from the number of constructs in this figure, that it is unfeasible to empirically test the entire model or even to gather real project data on that many variables. The conceptual model acts as a framework for the empirical research chapters and provides the glue and conceptual cohesion that helped to manage the broad set of topics into a coherent story. Only a limited number of its elements are covered in the empirical chapters. That is, I had to make choices on which parts of the model to aim for, which constructs to operationalize, and what data to gather. In paragraph 3.2 and 3.3 you can read more on this topic.

I chose for paradoxes.

The first paradox I discussed in paragraphs 1.7 and 2.5: the phenomenon that 'shared-as-in-common knowledge' is a prerequisite for its counterpart, 'shared-as-distributed (specialization) knowledge'.

The second paradox is related to conflict: the paradoxical situation that task and process conflict seem to be a necessity to build the required shared-as-in-common knowledge but that, on the other hand, these conflict types can also hurt team performance and limit communication and information exchange. In addition, the inconsistent findings on the effects of task and process conflict – both found to benefit as well as hurt team performance – increased my interest in conflict as a topic, aiming to find an explanation for these inconsistent findings.

The decision to focus on these paradoxes, on shared knowledge, conflict, the link between the two and their effects on team outcome guided the choice for the empirical chapters, which focus on conflict itself (spillover, transformation), affect management (emotion regulation), conflict management, and team cognition respectively.

The overview below shows which elements of the overall conceptual model (see Figure 9), are discussed in the empirical chapters.

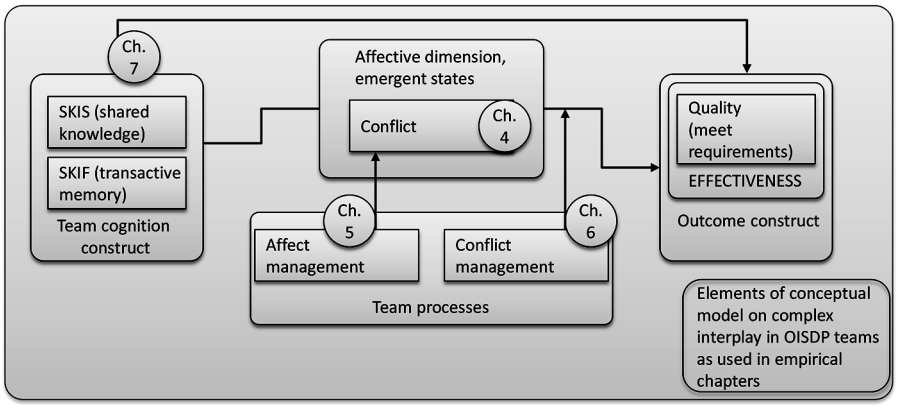

Figure 13 | Key concepts and relationships (empirical chapters)

3.2 | Variables, operationalization, considerations

As described in paragraph 1.10, Research Strategy, from the start of this research, I decided to aim for empirical, quantitative research based on multiple projects (as opposed to a small number of in-depth case studies). In addition, although my focus at this point was mainly on team cognition elements, I also had the model suggesting that other elements (such as conflict, coordination etc.) had to be measured. Finally, given the aim to use multiple projects in this research, I made the choice to use *surveys* and a physical, printed, questionnaire.

For this reason, the research discussed in the various chapters in this thesis is based on a broad dataset that operationalizes the constructs and elements in the overall team dynamics model (Figure 9 Conceptualization of Dynamics in OISDP teams). Data was collected using questionnaires and real IS development projects.

As discussed in paragraph 2.3.7, when discussing *shared* knowledge, both sharedness (similarity) and correctness (accuracy) are important. When discussing *distributed* knowledge, both completeness and quality (of the knowledge stock) are important. This suggests that, based on the team-dynamics model, I wanted to be able to measure and assess the following knowledge related variables:

Table 10 | Cognition related variables in empirical research

Cognition related	Description
SKIS – Shared Knowledge on the Information System (similarity)	Do team members share knowledge on the workings, goals etc. of the IS to be developed?
SKIS – Shared Knowledge on the Information System (accuracy)	Is the SKIS *accurate*?
SKIF – Shared Knowledge on the Interface (similarity)	Do team members share knowledge on the interface between the teams
SKIF – Shared Knowledge on the Interface (accuracy)	Is the SKIF *accurate*?
Transactive Memory / knowledge stock (completeness)	Reflect completeness of knowledge stock per (entire) team per project Analogy: do all team members combined possess sufficient knowledge – do they remember 'all the jigsaw puzzle pieces'
Transactive Memory / knowledge stock (quality)	Reflects quality of knowledge stock per (entire) team per project. Analogy: do they remember the jigsaw puzzle pieces *correctly?*
Transactive Memory / Specialization (on individual level)	Reflects the specialization on an individual basis per (entire) team per project. Related to distributedness of knowledge
Transactive Memory / Identification (similarity)	Do team members agree on who (on an individual level) knows what?
Transactive Memory / team specif. Knowledge identification (accuracy)	Is the identification *accurate* (that is: is the correct knowledge holder identified)?

SKIS – Shared Knowledge on the Information System

Respondents' perceptions:

In the questionnaire (Q 11), respondents were asked to provide their opinion on SKIS using a number of critical SKIS elements (including objectives of the Information system to be built, priorities, future users). The questions were phrased with a team emphasis. On a 5-point Likert scale, respondents were asked questions such as: 'to what degree do team members have knowledge regarding …' The replies (aggregated[7] per sub team respectively per MTS) provide a measure of similarity. That is: of SKIS. Please note that *accuracy* of SKIS (which is project dependent) can be assessed neither practically nor theoretically since there is no objective yardstick on what accurate SKIS is. A frequently made assumption in shared knowledge research is that high sharedness reflects accuracy. Where this may typically be true, conceptually the two are different. In this research, I did *not* establish an objective accurate SKIS yardstick therefore do not presume to assess SKIS accuracy.

[7] For SKIF and SKIS, individual scores were aggregated into sub team level and MTS level scores. For quality, individual scores were aggregated to MTS level. We computed $r_{WG(J)}$ scores (James, Demaree and Wolf, 1984) to check for sufficient within-group agreement. I checked for the recommended cutoff point of .70.

Measures:
In order to strengthen the robustness of the empirical research, I developed a second mechanism to measure SKIS sharedness. Other than questionnaire item Q 11 (referred to above) that asked opinions on (shared) knowledge, item Q 21 asked open questions on the same topics that were covered in Q 11. Respondents were asked to provide keywords describing one to three objectives, priorities, future users that they deemed most important for the project. After all responses were received, the answers were coded (double checked) and similarity was calculated. In a sense, this provides a 'real measured' SKIS number as opposed to the aggregate of opinions. Besides coding of the responses, a serious challenge was defining a way to calculate similarity between the coded answers of team members within sub teams and MTSs.

I started by looking at existing methods such as IRA (Inter Rater Agreement). It turned out that these methods do not provide a good fit because they are created for different purposes. IRA is meant to assess rater *agreement* which is not (a subtle but important difference) the same as similarity. Weighted IRA-like measures are more closely related to similarity but the weighted measures do not apply to open text answers. More importantly: IRA-like measures – by nature of what they are defined for – assume a (very) high level of consensus (agreement) and want to objectively determine a sufficiently high value to allow for further data manipulations. In this research, I am using open text data, therefore cannot assume *nearly full consensus* and have an altogether different purpose: I do not want to calculate consensus or agreement in order to (dis-) allow further aggregation, I simply want to have an indication of similarity, of sharedness in respondents' answers. A subtle but crucial difference. A final and practical issue in using IRA-like measure was the sparsity of data in the open text questions. IRA-measures do not work well with highly sparse data sets.
For these reasons, I defined a simple and straightforward, tailor made formula to provide an indication for similarity in answers within teams taking into account the specific context of this research and of its data (open text questions, relatively small sets of respondents per project, relatively sparse data as a result of the nature of the questions).

Characteristics of formula:
- Works for open question answers (after coding of responses).
- Allows for any number of respondents from 1 (in which case sharedness = 0) to n.
- Result from formula ranges from 0 (no similarity/sharedness) to 1 (maximum possible sharedness/similarity).
- Takes into account the specific situation that allows respondents to enter 1 to 3 answers per open text question by using both
  - number of responses and
  - number of respondents
  - (which are not necessarily the same since each respondent can provide 0 to 3 responses per question)

– The resulting sharedness measure is based on the number of times that a specific response is given and as such fully reflects the intended usage: similarity in answers which indicates sharedness of knowledge.

Definition of formula:
n = the number of respondents for this specific question
x = total number of responses for the specific question (open text responses, each respondent can provide 0...3 answers for each of the questions). This means that x ranges from 0 ... 3*n
i = counter
x_i = the number of responses that was given 'i' times
Final score: average over the 5 sub questions that belong to Q.21 (the key aspects that respondents were asked about).

$$\frac{\sum_{i=1}^{n}(i-1) * x_i}{x} * \frac{n}{n-1}$$

This formula has the benefits of being simple and of providing a common-sense and realistic indication for similarity that cleanly ranges from 0 to 1 based on the specific characteristics of the data (open text, multiple responses per respondent possible, potentially sparse data).

SKIF – Shared Knowledge on the InterFace
For determining SKIF, I followed a similar procedure as described above. The second set of items of Q 11 in the questionnaire asks for respondents' opinions on SKIF-elements and Q 20 follows the same mechanism and formula as described above.
Here as well, I measure *similarity or sharedness* regarding SKIF elements, I do not measure *accuracy.*

Transactive Memory / knowledge stock (completeness)
'Is complete task specific knowledge available in the team to allow the team to perform the task?'
This reflects completeness of knowledge stock. This variable refers to shared-as-distributed as opposed to shared-as-in-common.

Q 19 in the questionnaire lists the key deliverables of OISD projects (and leaves free text room for respondents to add potential important project-specific deliverables). Respondents are asked, per key deliverable, to write down (free text) the initials of the person, role, and team responsible. The number of key deliverables that have (or do not have) 'owners' is an indication of the completeness of the knowledge stock.

Notes
- The measurement is an indication since it uses people's reports on 'who is responsible'. It is possible that all deliverables do in fact have responsible people associated with them, but that the respondents are not aware of this fact. The measure in effect is *reported* knowledge stock completeness.
- As a result of the calculation: it can be expected that a higher number of respondents per project will also lead to a higher number of identified responsible people.

Transactive Memory / knowledge stock (quality)

This reflects quality of knowledge stock per (entire) team per project. Q 16 in the questionnaire lists the key deliverables of OISD projects (Q 17 provides free text room for respondents to add potential important project-specific deliverables). Respondents are asked, on a 5-point Likert scale, to judge on the team's ability to produce this specific deliverable.

Transactive Memory / Specialization

Specialization is measured using a 5-point Likert scale.

Transactive Memory / Identification

Do team members agree on who (on an individual level) knows/is responsible for what; this reflects consensus on team-related transactive-memory (specifically: knowledge identification). Similar to SKIS and SKIF discussed before, I do not measure *accuracy* of identification. Although it can be expected that high sharedness in identification suggests that the right person is identified, theoretically even in cases of high sharedness, people could be wrong and the wrong person (inaccurate) could be identified. Since there is no objective yardstick to evaluate knowledge accuracy, I do not measure accuracy.

As discussed above (knowledge stock), in Q 19 respondents' are asked to provide the initials of the person responsible for key deliverables. Using these initials (after coding), I use the same mechanism and formula as I used for SKIS and SKIF.

In addition to the questions and operationalization of team cognition elements, I operationalized:

Table 11 | Operationalization of variables in research

Variable	Related Questionnaire question
Project phase	Describes 4 phases and asks the respondent to check the appropriate phase.
Project details	Free text. Asks for: project size (number of team members); project duration (estimated); specific system development methods; specific project management methods.
Performance	Using a 5-point Likert scale (strongly disagree … strongly agree). Asks 14 questions related to on time, within budget, quality. Respondents are visually triggered to only answer the questions that are appropriate to the project phase (Q1.)
Communication	5-item, 5-point Likert scale (strongly disagree … strongly agree). Based on Eby et al. (1999).
Trust	7-item, 5-point Likert scale (strongly disagree … strongly agree). Based on Erdem (Shanahan et al., 2007).
Cohesion	6-item, 5-point Likert scale (strongly disagree … strongly agree). Shanahan et al. (2007).
Emotion regulation	7-item, 5-point Likert scale (strongly disagree … strongly agree). Based on Curşeu et al. (2012).
Conflict management	15-item, 5-point Likert scale (strongly disagree … strongly agree). Based on Montoya-Weiss et al. (2001).
Specialization	Discussed above. 5-point Likert scale (strongly disagree … strongly agree). Based on Lewis (2003).
Coordination	5-item, 5-point Likert scale (not at all … to a high degree). Based on Kraut and Streeter (1995).
SKIS and SKIF	Discussed above. 13-item, 5-point Likert scale (not at all … to a high degree). Research specific items.
Conflict	9-item, 5-point Likert scale (not at all … to a high degree). Based on Jehn and Mannix (2001).
Team learning	7-item 5-point Likert scale (not at all … to a high degree). Based on Chan et al. (2003).
Interface	Research specific question. 2-item, 5-point Likert scale (not at all … to a high degree).
Demographics	The final question in the questionnaire is related demographics including gender, age, education, experience.

3.3 | Method, Data collection

The empirical chapters in this thesis are based on research in a real life, IS development environment. IS development teams were identified that fit the research context of strategic IS development outsourcing implementations: non-collocated Multi-team systems of client and vendor sub teams working together on IS development projects based on a pre-defined contract describing conditions and products to be delivered. These MTSs and their sub teams are teams performing non routine tasks that involve high levels of information processing.

The teams invited to participate in the study are multi-team systems composed of client and vendor sub teams working on IS development projects in The Netherlands. With the consent of client and vendor organizations, 23 projects were identified. Each project represents an MTS that consists of a client and a vendor sub team. The 23 projects (46 sub teams) were spread over 21 different

client organizations in different industries. The client organizations were selected cross-industry (government: 11, financial: 4, telecom: 2, commercial: 4, services and health: 2). Projects were selected on a minimum duration to allow for team dynamics to develop (project duration ranging from 6 to 72 months, average 23.4 months).

All teams were contacted and per sub team, a contact person was established. Through these liaisons, team members were asked to participate in scientific research by filling out an extensive questionnaire.

Additional information on the selected projects can be found in paragraph 1.10, Research Strategy.

I used physical, printed questionnaire booklets to (a) increase response rates and (b) to allow for results on paper that can be easily and objectively checked and verified. Questionnaire booklets were sent in sufficient quantities to the liaisons who distributed the booklets among the individual team members who were asked to fill out the booklets in their own time but not later than four weeks after receiving the booklet to ensure that individual responses reflect a similar stage in the lifecycle of the project. The fact that the analysis focuses on Multi-team systems and sub teams implies that responses had to be identifiable on a sub team (not individual response) level and that therefore the questionnaire booklets were sub team specific. Each booklet contains an explanation on the context and on the fact that booklets are sub team specific but anonymous on an individual level. Respondents were enabled to return the physical booklets anonymously and free-of-charge thus the identities of the respondents are not known to the research team.

In total, 136 questionnaires were sent out, 94 booklets from 42 of the 46 sub teams were completed and returned within the specified timeframe. Of the respondents, 81 were male, 10 female, 3 respondents did not report their gender; respondents' ages vary from 24 to 63 with an average age of just over 42. Following the suggestion of Biemann and Heidemeier (2012), I kept for further analyses all MTSs with at least two respondents and the number of respondents per project ranged from 2 to 10 with an average of 4.1 respondents per project. The data in the booklets received was coded into SPSS for analysis. Each of the questionnaires contained a broad set of variables; the combined data from the questionnaires provided me with a broad (in the sense of 'many variables') dataset that I intended to use for multiple empirical papers and chapters.

A note: according to Kirkman and Chen (2011) there is a grey area regarding publishing multiple papers from a single dataset. Following their suggestion, I created a *uniqueness analysis* matrix in which I confront the chapters[8] 2, 4, 5, 6, and 7 (the columns) and various elements (such as research question, variables used etc.) of these chapters as the rows of the matrix. The matrix shows that the focal areas of the chapters and the breadth of the dataset allow for the intended approach.

[8] Please note that chapter 3 is *not* included in this analysis since it is a reflection on research and data.

Table 12 | Uniqueness Analysis, based on Kirkman and Chen (2011)

	Chapter 2	Chapter 4	Chapter 5	Chapter 6	Chapter 7
chapter	Theoretical Chapter: Team Cognition in OISDPs	Empirical Chapter: Conflict spillover and conflict transformation in OISDPs	Empirical Chapter: Emotion regulation and conflict transformation in OISDPs	Empirical Chapter: Conflict and Conflict Management in OISDPs	Empirical Chapter: Team Cognition and its effects on outcome in OISDPs
note(s)	Note: this chapter is not produced *from* the dataset; this chapter (or the model it discusses) *led to* the dataset used for subsequent empirical research. The chapter is listed for completeness.	This empirical chapter focuses on conflict spillover and conflict transformation – in cross organizational client/ vendor information systems development teams (Multi-Team Systems or MTSs).	The purpose of this chapter is to examine the role that emotion regulation plays in the potential transformation of both task conflict and process conflict into relationship conflict	This empirical chapter focuses on the effects that different conflict management styles have on the relationship between conflict and outcome in OISDPs.	This empirical chapter focuses on the dilemma of knowledge sharing and overlap versus specialization and uniqueness, and on their effects on team performance in a Multi-team System.
Research Question	Based on (combining) existing literature streams and findings, can I create a theoretical model that supports a better understanding of the dynamics in Multi-Team Systems responsible for Outsourced Information Systems Development Projects?	In the context of a Multilevel Multi-team System, how do different conflict types (process, task, and relationship) interact or transform and do I find cross level conflict spillover effects?	What role does emotion regulation play in the (potential) transformation of process and task conflict into relationship conflict?	What are the effects of task and process conflict on team performance; is the relationship between sub team level conflicts mediated by MTS level conflict and do different types of conflict management show different moderating effects on the relationship between conflict and outcome?	What are the effects of shared knowledge on outcome in the context of client and vendor IS development teams (cross organizational Multi-Team Systems). What role do shared mental models and transactive memory play?

	Chapter 2	Chapter 4	Chapter 5	Chapter 6	Chapter 7
Theories Used	Outsourcing Team, Team Cognition IS development Multi-Team Systems	Team and Multi-Team Systems Literature Conflict	Team and Multi-Team Systems Literature Conflict Emotion Regulation	Team and Multi-Team Systems Literature Conflict Conflict Management	Team and Multi-Team Systems Literature Team or Shared Mental Models Transactive Memory
Constructs, variables	Research Question #1 focuses on an overall theoretical model, therefore touches upon a large number of constructs and variables. For readability: the list is presented in the appendices - please refer to appendix 9.1	Relationship Conflict on Multi-team Level Process Conflict on Multi-team Level Task Conflict on Multi-team Level Relationship Conflict on Sub Team Level Process Conflict on Sub Team Level Task Conflict on Sub Team Level	(individual perception of) task conflict (individual perception of) process conflict (individual perception of) emotion regulation group relationship conflict group process conflict	Quality (of output of OISDP) Process Conflict on Multi-team Level Task Conflict on Multi-team Level Process Conflict on Sub Team Level Task Conflict on Sub Team Level Conflict Management (avoiding, accommodating, Collaborative)	Quality (of output of OISDP) SKIS = Shared Knowledge on the Information System: a research specific variable based on shared mental model theory (shared-as-in-common). SKIF = Shared Knowledge on the InterFace: a research specific variable based on transactive memory theory (shared-as-in-distributed).

	Chapter 2	Chapter 4	Chapter 5	Chapter 6	Chapter 7
Theoretical Implications	The overall model supports better understanding of the dynamics in client/vendor Multi-Team Systems responsible for Outsourced IS development Projects; It does so by combining insights from existing literature and empirical research and by providing an overall, integrated model.	Different conflict types have different effects on team outcomes. Some beneficial, some detrimental. Understanding potential spillover and transformation effects in Multi-Team Systems will provide insights in the way that conflict develops in Multi-Team Systems.	Can I find moderating effects of emotion regulation on the relationship between perceived process conflict, perceived task conflict and team relationship conflict? For the statistical analysis, the chapter will combine personal and team level data – an innovative approach following Glomb and Liao (2003)	We will examine cross level mediation and moderation effects between task and process conflict and conflict management styles. For the statistical analysis, the chapter will confront traditional Baron and Kenny (1986) techniques with alternative bootstrapping methods (Hayes, 2009).	Empirically grounded insights in the roles that shared (in common, shared mental model) and shared (distributed) knowledge (transactive memory) play in Multi-team IS development Systems.
Managerial Implications	The overall model is an awareness tool, providing project, delivery, and contract managers with an overall perspective on the elements that play a role in their daily OISDP realities. In doing so, the model provides guidelines on how to better manage those complexities.	Understanding conflict dynamics in and between sub teams will allow managers to actively manage and potentially even actively use conflict to increase their sub team's and the MTS' performance.	Provide practical pointers to managers to support them in managing or even preventing conflict by understanding and actively stimulating potentially moderating emotion regulation strategies. Offer guidelines to prevent task or process conflict to transform into relationship conflict.	Better understanding allows managers to apply optimal conflict management styles at the right moment to positively influence team performance.	Many outsourced IS development projects lack quality (end result) or efficiency (too late, too expensive). One of the reasons may be lack of investment in shared knowledge. Provide insights and guidelines to managers to more effectively create the necessary knowledge base required for successful cooperation whilst at the same time be aware of the costs of building and maintaining shared knowledge given the importance of specialization in OISDPs.

3.4 | Multilevel and nested data

"*Multilevel theoretical models are relevant to the vast majority of organizational phenomena*" (Kozlowski & Klein, 2000). This research focuses on Multi-team systems and looks at multilevel effects. OISDP Multi-team Systems (MTSs) involve different levels of dynamics: personal, within component team (client or vendor sub team) and cross component team, intra MTS. One of the potential issues with multilevel research is the unit problem (Mathieu & Chen, 2011), which refers to the fact that typically, lower level entities are members of more than just one higher level unit. The OISDP MTS, by virtue of it being a project team, is a temporary structure. Its component teams structurally belong to their respective parent organizations and temporarily to the (project-) MTS. In this sense, the component teams are neatly nested (Mathieu & Chen, 2011).

The multilevel aspect of this research poses various specific demands on analysis.

As Kozlowski and Klein (2000) suggest, *the assumption of isomorphism of shared unit properties should be explicitly evaluated to establish the construct validity of the aggregated measure.* I aggregated group and MTS level conflict scores under the homogeneity assumption (individuals in sub groups and MTS should agree on the level of conflict they experience). I calculated the within group agreement index (r_{WG}) before data from the individual questionnaires were aggregated into team level scores. I excluded from the analysis the MTSs and sub teams for which the values were lower than 0.70 (the recommended cutoff point).

The data on sub teams and MTSs were collected using the same sources since respondents were asked to provide feedback on both sub team and MTS. To mitigate, in the questionnaire, the reference point was explicitly shifted from sub team to MTS. In addition, (example) the regression model in for instance the chapter on emotion regulation (chapter 5) is set up with the dependent variable aggregating the evaluation of other team members (minus the focal person), which can in fact be considered an independent source. (OLS regression has been adapted to examine cross-level and multilevel effects in organizational research (Kozlowski & Klein, 2000)). A more detailed example: I evaluated task and process conflict at the individual level, representing a focal individual's perception. Team relationship conflict was measured as the average perception of relationship conflict in the team excluding the focal individual. This approach allows for assigning (different) group level scores to each individual and regressing the individual perception variables on team level relationship conflict (with the focal person excluded) allows for reducing the common method variance in our analyses (Glomb & Liao, 2003). On top of that, because the results of the OLS are likely to be influenced by endogeneity (members in the same group are likely to report similar levels of conflict) and because individuals are nested in groups I conducted a supplementary multilevel analysis and found that the two methods yield highly consistent results supporting the significant effects.

Another issue is the fact that, in the empirical chapters, I test cross-level and single level (either sub team or MTS level) hypotheses. Using multilevel regression to test hypotheses that touch both sub team and MTS level requires a dataset containing both MTS and sub team level data. On the other hand, if that same dataset would be used to test MTS-level only hypotheses, the results would be inflated as a consequence of each MTS consisting of two sub teams. I therefore created a separate, MTS level only, dataset.

3.5 | References

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CHAPTER 4

Conflict Spillover and Conflict Transformation in Multi-team IS Development Systems

Abstract

This empirical chapter investigates human interactions – focusing on conflict, conflict spillover, and conflict transformation – in cross organizational client/vendor information systems (IS) development teams (Multi-team systems or MTSs). Findings show that task, process, and relationship conflict spill over from sub team level to the MTS level. The main practical conclusions are that project managers who lead either a sub team or an MTS must be aware of these different types of conflicts and their interactions to successfully deliver their projects' required results.

Keywords: Conflict, Inter organizational Multi-team systems, project management

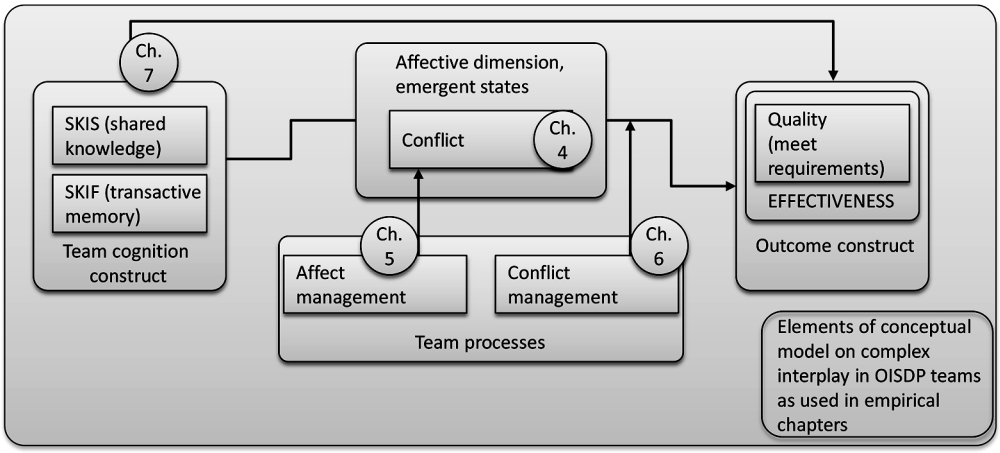

Figure 14 | Positioning chapter 4

4.1 | Introduction

Large IS development projects are often not built 'in house' but by external software development service providers. Complex combinations of cosourcing, outsourcing and other hybrid sourcing models are concocted by theorists, often to find out that there is a difference between theory and contracts on the one hand, and reality on the other. In the end, the actual implementation of these sourcing models boils down to day to day activities under time pressure and interpersonal interactions – often marked by conflict – as the people involved (from both client and vendor organizations) have divergent goals. This contested reality especially holds for fixed price/result projects in which responsibility for delivery of the actual software development is put into the hands of the vendor organization, within pre specified timeframes and budget, and against pre-defined quality criteria. Inherent to such projects are issues related to cooperation, commitment, conflict, power and dependency from the beginning of the venture (Kern & Willcocks, 2000). Several empirical studies report that 20-25% of all software outsourcing relationships (including IS development outsourcing) fail within two years, that 50% fail within five years (Oza, 2006), and that nearly 70% of the companies that outsourced are unhappy with one or more aspects of their involvement with vendors (Oza, 2006). A key reason for these failures has been found to be related to the relationship aspect of an outsourcing venture (Fleming & Low 2007; Jahner, 2007; Oza, 2006 Koh et al., 2004; Kishore et al., 2003; Kern & Willcocks, 2000; Kern, 1997). It can therefore be expected that conflict and conflict resolution play an important role and that on top of the theoretical research into sourcing models, field research into daily practices, processes and interaction will provide pragmatic and useful insights.

This chapter takes an interdisciplinary perspective (not strictly IS) and leverages research into team dynamics and multi-team systems to explore conflict spillover and transformation.
So far, very few researchers devoted effort to use the setting of multi-team systems to study distinct types of intra group conflict and their contagiousness. Although not frequently recognized as such, MTSs are a common phenomenon in the IT world. With an increasing number of clients outsourcing all or part of their Information Systems (IS) development to commercial vendors, the task of successfully delivering required project results has become the reciprocal responsibility of clients and vendors cooperating in such MTSs. A key characteristic of these MTSs is that they do share common distal goals (such as successful delivery of projects and IS development) but also have different and even contradicting proximal goals (the simplest example is money – cost for one is revenue for the other), which is a potential source of conflict.

This research examines distinct effects of various types of conflicts, as well as their impact on project performance. In line with the group conflict literature I discern: task conflict (divergences on task definition), process conflict (disagreements on role assignment and other issues related to how the task is going to be accomplished) and relationship (interpersonal frictions) conflict (Jehn, 1995). The three types of conflict have qualitatively different influences on task performance and display complex patterns of interrelatedness (De Wit et al., 2012). This study sets out to test the

multi-dimensional interplay between these three types of conflict in MTSs: (1) the way in which different forms of conflict impact on each other and (2) the way in which different forms of conflict experienced by the sub teams composing the MTS affect the macro level dynamics of the MTS.

This empirical study has important contributions to the IS literature in bringing together insights from team research, MTS research, and IS research; it adds to team literature by extending the insights on MTS dynamics by exploring the conflict spillover in MTS. The relationships between conflict types in the context of IS Multi-team systems were – to the best of my knowledge – not reported upon before. Finally, this study and findings have practical and managerial implications for practitioners such as project managers in the field of large IS development projects.

4.2 | Theoretical background

A *project* in terms of the international ISO standard is defined as "*an endeavor with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements"* (Savolainen et al., 2011). In this chapter, I study outsourced IS development projects – that is, projects with a sub-contracting relationship involving two parties, a customer and a vendor. Following Savolainen et al.'s (2011) description: the client is acquiring software that is specifically developed on behalf of this client by a vendor. Client and vendor are from different organizations and their relationship is governed by a formal contract regarding the software development project. Over the last 20 years, we witnessed a trend towards outsourcing of ICT activities (Oza, 2006). At the same time, team and project based development have become mainstream, both within the ICT market as well as in other market sectors. The design and development of large Information Systems (IS) requires knowledge from multiple domains and as a consequence, requires coordinated group effort (Crowston & Kammerer, 1998). In effect, this means that a growing number of today's large and complex information systems are being developed by MTSs consisting of client and vendor sub teams.

In line with Mathieu et al. (2001, p 291) I argue that each MTS (a) is composed of two or more (sub) teams (b) is a unique entity larger than its sub teams but smaller than the organization(s) that the sub teams belong to (c) its sub teams are interdependent (d) is an open system and (e) its sub teams may have different proximal goals, they also share a common distal goal. In this research, the two sub teams belong to different organizations, hence these MTSs are inter organizational MTSs.

Research has shown that knowledge sharing among project team members is crucial for project performance (Han & Hovav, 2013) and that teams in system development must share information about tasks in order to be successful (Hsu et al., 2011). IS development projects are typically complex, dynamic, and unstructured and require the communication of knowledge and expertise from different domains (Hsu et al., 2011; Tesch et al., 2009).

Conflict types and findings relating conflict to team outcomes and team performance were introduced and described in paragraph 2.3.5. In short: relationship conflict involves interpersonal frictions, task conflict relates to disagreements about (collective) goals and task definition and process conflict reflects disagreements over logistical issues, task distribution and scheduling (Behfar et al., 2011; Greer et al., 2008). Task and process related conflict may be a necessity for the sub teams in the MTS to exchange ideas and viewpoints. A team's ability to share and utilize available information is critical to the success of a project (Hsu et al., 2011; Mesmer-Magnus & DeChurch, 2009). On the other hand, conflict in teams may hamper information flows and distract from the work at hand. It can therefore be expected that conflict plays an important role in the build-up of the necessary shared knowledge in both sub teams and the MTS.

It can be expected that in these cross organizational IS development MTSs, process conflict plays an important role given the formal and contractual obligations that govern the client/vendor relationship; contractual obligations that are closely related to responsibilities and process issues like who does what. Moreover, specialization and division of labor between client and vendor are key characteristics of these IS development projects, suggesting that disagreements on division of labor are likely to emerge in the MTS.
Furthermore, I suggest that in the context of cross organizational client/vendor IS development MTSs, all three conflict types are of relevance not only intra- but also inter sub team. I expect to see spillover effects of intra sub team conflicts to the MTS level and expect to see interdependencies between MTS level and sub team level conflict above and beyond the intra team interdependence between relationship, task and process conflict.

Research to date shows that the three types of conflict are (positively) correlated and that the dynamic interplay of the three types of conflict has important implications for group performance (De Wit et al., 2012; Greer et al., 2008; DeDreu & Weingart, 2003). Despite the strong association between the three types of conflict as reported in empirical research (De Wit et al., 2012; Greer et al., 2008; DeDreu & Weingart, 2003), they are conceptually distinct. Findings by Behfar et al. (2011) show that group members spontaneously distinguished between the three types of conflict in Jehn's typology (Behfar et al., 2011). To conclude, given that (1) the three types of conflict are conceptually distinct, (2) relationship conflict is detrimental, while task and process conflict are potentially beneficial for group performance, and (3) the three types of conflict are positively related, it becomes important to understand the conditions under which task and process transform into relationship conflict.

The concept of *conflict spillover* as used in this chapter refers to intra domain (that is – intra conflict type), cross (multi-) level spillover effects such as process conflict spillover from sub teams to process conflict in the MTS that they are part of. This is a different concept from *conflict transformation* reflecting the transformation of one conflict type to another such as from task related disagreement to process and relationship conflict (DeWit, et al., 2012; DeDreu & Weingart, 2003), from process conflict to task and relationship conflict (Greer et al.,2008), and from task conflict to relationship conflict (Curşeu & Schruijer, 2010).

Based on the theory and findings described above, my hypotheses focus on the multi-dimensional interaction and spillover between the various conflict types and across sub team and MTS level.

4.3 | Hypotheses

Understanding the dynamics of conflict in the context of the cross organizational MTS in outsourced IS development may even be more important than in intra organizational MTSs. This because the distal goal (Mathieu et al., 2001) may be shared by the sub teams in our MTS (a successfully built Information System), the proximal goals are not. IS development cross organizational MTSs have an inherent conflict built into their existence; understanding the dynamics of conflict in these cross organizational MTSs is therefore of critical importance.

Teamwork and team performance in knowledge intensive teams depend on communication and the sharing of information (Mesmer-Magnus & DeChurch, 2009). Relationship conflict was (1) found to be negatively associated with communication (Dibbern et al., 2004) (2) limits information processing because members spend time and energy focusing on each other rather than on the task (Greer et al., 2008; Simons & Peterson, 2000; Pelled, 1996), and (3) limits group members' cognitive functioning by increasing their stress and anxiety levels (Behfar et al., 2011; Yang & Mossholder, 2004; Simons & Peterson, 2000).

Two meta analyses (DeWit, et al., 2012; DeDreu & Weingart, 2003) on the impact of intra group conflict on group outcomes show rather high inter correlations between different types of conflict. This shows that disagreements in a particular domain (e.g., task related) are often associated with conflicts in other domains (e.g., relational and process). Contrary to their expectations, Greer et al. (2008) did not find relationship conflict and task conflict at the beginning of a team's life to be related to other conflict forms later in the team's existence. The tentative explanation provided by Greer et al. (2008) is that task and relationship conflict are not as ambiguous as process conflict. This ambiguity could be the reason for process conflicts to carry over to task and relationship conflicts (Greer et al., 2008). They also found that process conflict occurring early in a team's interaction leads to higher levels of both task and relationship conflict later in the team's interactions but that this effect can be limited if the process conflicts are solved at the start (Greer et al., 2008). On the other hand, findings by Ensley and Pearce (2001) show that task conflict is positively related to affective conflict within management teams. Similar results are reported by Curşeu and Schruijer (2010), showing that task conflict in the initial stages of group interaction is positively related to relationship conflict experienced at later stages, while relationship conflict experienced in the initial stages of group interactions decreases the chances of task conflict later on.

Empirical evidence has shown that task conflict has a high association with relation conflict (Ensley & Pearce, 2001) and as such may turn out to be detrimental to performance (Greer et al., 2008; Jehn, 1997, 1995) as a consequence of the transformation of task conflict into relationship conflict.

Prolonged and intense task conflict was found to transform into relationship conflict (Curşeu & Schruijer, 2010; Yang & Mossholder, 2004; Mohammed & Ringseis, 2001; Simons & Peterson, 2000; Jehn, 1997).

I expect that task conflict in a sub team – especially when prolonged – will lead to relationship conflict.

Process conflict was also found to transform into relationship conflict. Explanations involve the personal value that people pay to roles and task responsibilities (Greer et al., 2008). Findings by Greer et al. (2008) show that process conflict occurring early in a team's interaction leads to higher levels of both task and relationship conflict later in the team's interactions (but that this effect can be limited if the process conflicts are solved at the start) (Greer et al., 2008).
I expect that prolonged process conflict in a sub team will lead to relationship conflict.

***Hypothesis S1**. Within a sub team, I expect that both task conflict and process conflict are predictive of relationship conflict.*

Multi-team system

I posit that the reasoning regarding the relationship between relationship conflict and task conflict as discussed on sub team level, also applies to the MTS level. I therefore expect task conflict to be predictive of relationship conflict in the MTS.

However, for the relationship between process conflict and relationship conflict, I expect different dynamics on the MTS level as compared to the sub team level. Where process conflict on the sub team level is likely to be associated with personal values and responsibilities, this is not to be expected on the MTS level. Discussions on roles and responsibilities on the MTS level will not be associated with personal values but will be discussed based on contractual obligations. On this level, process conflicts typically focuses on what is or is not covered by the contract and disagreement about these issues can be expected to be more formal and contractual as opposed to personal ('It is not about you and me but about what our organizations agreed upon contractually'). Different from the dynamics at the sub team level, I therefore do not expect process conflict to transform to relationship conflict in the MTS but do expect a similar predictive relationship between task conflict and relationship conflict.

***Hypothesis M1**. Within the MTS, I expect that task conflict is predictive of relationship conflict*

Spillover: cross level and cross conflict domain interactions

I expect to find intra conflict domain spillover effects. This can be explained by regarding task conflict. If a sub team has high levels of task conflict, this signals that they cannot come to an agreement on the task at hand, on what needs to be done, or on the required outcome. If on the (lower level) sub team such agreement cannot be reached, it can be expected that the (higher level) MTS will be

used as 'the next escalation level', leading to task discussions and conflict in the MTS. For process conflict, I would expect to see a more limited spillover effect given the reasoning above on the role of the contractual obligations that to a large degree establish the responsibilities across sub teams. Personal disliking and relationship conflicts will not disappear in the context of the MTS and may even lead to coalition forming on that level. A negative atmosphere intra sub team can be expected to be reflected in the MTS.

***Hypothesis C1**: for all three conflict types, I expect to find intra conflict domain spillover effects from sub team to Multi-team system level.*

On the other hand – with the exception of relationship conflict that is consistently found to be detrimental to team performance – previous research is available in which task and process conflict have been found to benefit team performance. This can be explained by the necessity for shared knowledge in IS development teams. In summary: task conflict can benefit team performance by (1) allowing for better decisions because of a better cognitive understanding of the issue being discussed and as a result of divergent thinking (Behfar et al, 2011; Greer et al., 2008; Peterson & Behfar, 2003; Simons & Peterson, 2000; Pelled, 1996), (2) leading to better acceptance of decisions since team members will feel that they were heard (Simons & Peterson, 2000), (3) leading to greater team confidence and effectiveness (Yang & Mossholder, 2004), (4) stimulating engagement and increase commitment to the task (Behfar et al., 2011; Greer et al., 2008); process conflict may benefit performance by (1) leading to explicit agreements about how the group will work together to complete tasks in a timely manner, (2) supporting explicit agreements that help clarify issues such as roles and responsibilities (Goncalo et al., 2010).

This leads to the following reasoning: high levels of task conflict on the sub team level may require task discussion on the MTS level in order to resolve the issues. Whereas this may lead to increased task conflict on the MTS level, it will, as a side effect, also lead to increased communication in the MTS, between the sub teams. This in turn is expected to allow the sub team members to establish communication patterns and build up knowledge on each other's expertise. A side effect then, is increased clarity on a process level. Therefore sub team level task conflict can be expected to be mitigating MTS level process conflict. This leads to the following cross domain spillover hypothesis.

***Hypothesis C2**: Higher levels of task conflict on the sub team level will be associated with lower levels of process conflict on the MTS level.*

4.4 | Method

Data collection and sample that underlie the empirical chapters are described in chapter 3, paragraphs 3.2 and 3.3.

Measures

Over the past decades, multiple scales were developed to measure conflict. For this research, I decided to use the adapted scale that Jehn and Mannix (2001) published and that covers all three types of conflict (relationship, task, process). The scale is a 9 item, 5 point Likert scale with 3 questions per conflict type. The scale was translated to Dutch. Respondents were asked to answer each question both with respect to their own sub team as well as reflecting the MTS project team as a whole. In essence, this means that respondents were asked to answer the nine items of the conflict scale twice – on MTS and on sub team level. Cronbach's alphas for all scales are well above the accepted threshold and are presented in Table 13. In this table I also report the means, standard deviations and correlations between the variables used in the study. In line with previous research on intra-team conflict, I observe high correlations between the three conflict types, suggesting limited differential validity on the scales. However, findings in both my own and previous research do suggest that looking at the interactions of these variables may be of interest – hence I will consider them as separate variables in the analysis.

Table 13 | Descriptive Statistics

	Variable	mean	std dev	1	2	3	4	5	6
1	e_RelCfl_ET	2,10	0,56	(.89)					
2	e_TaskCfl_ET	2,42	0,50	0,84***	(.76)				
3	e_ProcCfl_ET	2,10	0,53	0,63***	0,82***	(.83)			
4	s_RelCfl_OT	1,89	0,59	0,47***	0,51***	0,56***	(.85)		
5	s_TaskCfl_OT	2,24	0,54	0,43***	0,57***	0,41**	0,66***	(.72)	
6	s_ProcCfl_OT	1,86	0,65	0,31	0,49***	0,61***	0,70***	0,52***	(.82)

n=35, *** p < 0.01 , ** p < 0.05, * p < 0.1

e_RelCfl_ET reflects the level of Relationship Conflict in the Multi-team system (the suffix ET represents Entire Team)
e_TaskCfl_ET reflects the level of Task Conflict in the Multi-team system (the suffix ET represents Entire Team)
e_ProcCfl_ET reflects the level of Process Conflict in the Multi-team system (the suffix ET represents Entire Team)
s_RelCfl_OT reflects the level of Relationship Conflict in a sub team (the suffix OT represents Own Team)
s_TaskCfl_OT reflects the level of Task Conflict in a sub team (the suffix OT represents Own Team)
s_ProcCfl_OT reflects the level of Process Conflict in a sub team (the suffix OT represents Own Team)

I calculated the within group agreement index (r_{WG}) before data from the individual questionnaires were aggregated into team level scores. I excluded from the analysis the MTSs and sub teams for which the values were lower than 0.70 (the recommended cutoff point). I used the 'OwnTeam' values to calculate r_{WG} on the intra sub team level, the 'EntireTeam' values for the MTS. The r_{WG} values suggested dropping 2 sub teams and 2 MTSs from our analysis. The remaining teams show r_{WG} values from 0.77 (sub teams) and 0.73 (MTSs) upwards and allow for aggregating scores on sub team and MTS levels.

4.5 | Results

The data is based on perceived conflict that is reported upon by respondents on both 'own sub team level' as well as 'multi-team system level'. Due to the hierarchical nature of data, I used multilevel analysis, exploring the way in which perceived conflict at the MTS level is influenced by perceptions of conflict at the sub team level. I used a mixed model procedure in the PASW 17 package. The results of this multilevel analysis show that a particular type of conflict experienced at the sub team level has domain specific spillover effects at the MTS level. The results of the multilevel analysis are reported in Table 14.

Table 14 | Multilevel analysis on conflict-perception across team-levels

	MTS level RC		**MTS level TC**		**MTS level PC**	
	Estimate (SE)	t(p)	Estimate (SE)	t(p)	Estimate (SE)	t(p)
Team level RC	0.560 (0.18)	3.15 (0.00)	-0.032 (0.15)	-0.22 (0.83)	0.052 (0.16)	0.32 (0.75)
Team level TC	0.033 (0.16)	0.21 (0.84)	0.550 (0.14)	3.99 (0.00)	-0.033 (0.15)	-0.22 (0.83)
Team level PC	0.145 (0.14)	1.03 (0.30)	0.183 (0.12)	1.53 (0.13)	0.686 (0.13)	5.27 (0.00)

RC = Relationship Conflict
TC = Task Conflict
PC = Process Conflict

The results of this multilevel analysis show that a particular type of conflict experienced at the sub team level has domain specific spillover effects at the MTS level.

In order to further explore the conflict transformation within groups, I performed an OLS regression analysis with the aggregated sub group scores for the three types of conflict. The results for the sub team level conflict transformation can be found in Table 15.

Hypothesis S1 suggested the predictive value of task conflict for relationship conflict (supported with β=0.40), and of process conflict for relationship conflict (supported with β=0.49).
As discussed before, (prolonged) task and process conflict have been found to transform into relationship conflict. To explore the conflict transformation at the MTS level, as well as the conflict spillover effects from the sub team to the MTS as a whole, a series of OLS regression analyses were conducted with the conflict perceptions aggregated at the MTS level as dependent variables and the conflict scores aggregated at the group and MTS level as independent variables. The results for the MTS level interactions can be found in Table 16.

The results for the sub-team level interactions can be found in the table below.

Table 15 | Intra sub-team level analysis

Dependent variable	sub team level RC	sub team level TC	sub team level PC
Step/predictor	Model 1	Model 1	Model 1
sub team level RC		0,57***	0,63***
sub team level TC	0,40***		0,11
sub team level PC	0,49***	0,13	
AdjR²	0,58***	0,40***	0,47***
FChange	24,45***	12,45***	15,77***

*** p < 0.01 , ** p < 0.05, * p < 0.1

Results for the cross-conflict-domain and cross-team-level interactions can be found below.

Table 16 | Results of the regression analyses using the aggregated scores for conflict

Dependent variable	MTS level RC		MTS level TC		MTS level PC	
Step/predictor	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
1. MTS level RC			0.54***	0.49***	-0.22	-0.23
MTS level TC	1.01***	1,09***			1.01***	0.97***
MTS level PC	-0.20	-0.25	0.49***	0.49***		
2. Team level RC		0.30*		-0.19*		0.21
Team level TC		-0.20		0.27***		-0.31**
Team level PC		-0.17		0.02		0.22*
AdjR²	0,70***	0,72	0,84***	0,87**	0,67***	0.75**
FChange	41.32***	1.67	91.50***	3.68**	35.83***	4.42**

*** p < 0.01 , ** p < 0.05, * p < 0.1

Hypothesis M1 discussed the expected predictive value of task conflict for relationship conflict (supported with β=1.01, p < 0.01).
Regarding process conflict and relationship conflict on the MTS-level: Predicting non-results is tricky given the OLS-tests being based on inferential logic rejecting the null hypothesis. I suggested that I did not expect process conflict on the MTS level to be predictive for relationship conflict. The findings show a non-significant relationship between the two (β= -0.2). My suggestion is not contradicted by the findings.

I did find a number of unpredicted significant results on the MTS level that are not found on the sub team level (MTS TC → MTS PC, β=1.01, p < 0.01 and MTS PC → MTS TC, β=0.49, p < 0.01).
These effects might be explained by the fact that at the MTS level (compared to the sub team level), the 'task' and 'process' domains are more closely intertwined. On the MTS level, responsibilities and

tasks of the sub teams are governed by a formal contract, hence much more explicitly delineated than on the sub team level. On the MTS level, task content and task width discussions will easily lead to discussions on which team is responsible for the work being discussed. Conversely, process discussions are inevitable on the MTS level – both from a contractual perspective as from the fact that the two sub teams need to establish a working relationship and coordinate work. Discussing process and responsibilities on this level will have to include discussions on the content of the task. This reasoning may explain the strong correlation between MTS task and process conflict that is not found on the sub team level.

Hypothesis C1 suggested intra conflict domain, cross team level spillover effects. With, β=0.30 for relationship conflict, β=0.27 for task conflict and, β=0.22 for process conflict, C1 is marginally supported as these values are only marginally significant.

Hypothesis C2 predicted that sub team level task conflict would be negatively related to MTS level process conflict. With β= -0.31, C2 is supported by the analysis.

One (marginally) significant result that I did not predict is the interaction between sub team level relationship conflict and MTS level task conflict (β= -0.19) suggesting that increased levels of relationship conflict on the sub team level lead to lower levels of task conflict in the MTS. This particular result is in line with the correlations reported in Curşeu and Schruijer (2010).

4.6 | Discussion and managerial implications

I studied real life inter organizational teams in the context of outsourced IS development and examined the intra sub team and inter sub team dynamics of various types of conflict. As expected, I found that the relationships between conflict types on the intra organizational sub team level are different from the relationships between conflict types on the inter organizational MTS level. I also found the expected conflict domain specific spillover effects. These findings support the call in previous research for a multilevel focus to better understand teams. With these findings, I bring insights from (multi)team research into the daily life of project managers and into strategic IS research.

This study expands on previous research on intra group conflict by investigating the interplay of task, process and relationship conflict in a real world multi (project) team systems setting. DeChurch and Marks (2006) suggested that future research is needed that explores how systems of teams interact effectively. Second, whereas previous research pointed towards the need to further explore intra group conflict in a comprehensive multi-dimensional way, by including both individual perceptions and group level aggregates (Jehn et al., 2010), this study adds yet another level to this multi-dimensional dynamics of conflict in teams: that of the inter group dimension, highly important for MTS dynamics (DeChurch & Marks, 2006). The findings in this chapter significantly contribute to the

MTS literature as well as extend the insights on MTS dynamics by exploring the conflict spillover in MTS. I provide initial evidence that conflict experienced in the sub teams is contagious to the larger MTS. In line with DeChurch and Marks (2006) I provide empirical evidence for the distinctiveness of within and between sub team dynamics in MTS. Both levels should be explored when analyzing MTS dynamics and effectiveness. Moreover, I show that the interaction between various conflict types on a sub team level is different from the interplay on the MTS level. Therefore it is important to conceptualize MTSs as multilevel dynamic entities with distinct group and inter group dynamics and to further explore the cross level interactions in conflict transformation and escalation.

From a practitioners and managerial perspective, these findings have important implications since a relationship between conflict and team performance was frequently established in previous research (DeWit et al., 2012; Jehn et al., 2010; Greer et al., 2008; Passos & Caetano, 2005; DeDreu & Weingart, 2003; DeDreu & van Vianen, 2001; Ensley & Pearce, 2001; Jehn & Mannix, 2001; Montoya-Weiss et al., 2001; Jehn, 1997; Jehn, 1995; Pelled, 1995).

Understanding and pro actively managing and even using conflict will help sub team and MTS project managers to more effectively manage their teams and increase team performance. For example, whereas managers may typically recognize interpersonal (relationship) conflicts and intervene to resolve these, they may not be aware of the conflict spillover and transformation effects, nor may they be aware that task- and process conflict can actually benefit team performance. Following previous findings (Curşeu, 2006; Jehn, 1995; Fiol, 1994), it can be expected that in IS development sub teams the beneficial effects of task conflicts outweigh the potential negative effects: Curşeu states that "in general, task conflict is beneficial for team performance in tasks involving information processing" by increasing "the quality of discussions as well as the acceptance of decisions" and that, therefore, "task conflict is beneficial for the emergence of complex cognitive structures at the team level" (Curşeu, 2006, p. 257). Jehn (1995) explains "that Inadequate knowledge or assessment can lead to poor decisions and inferior products" and that as a consequence, "Groups performing nonroutine tasks benefit from the diverse ideas of group members" (Jehn, 1995. p. 260). Jehn further reports that findings show that "in groups performing nonroutine tasks, disagreements about the tasks did not have a detrimental effect, and in some cases, such disagreements were actually beneficial" (Jehn, 1995. p. 275). Fiol suggests that is "possible for groups to simultaneously agree and disagree", and that this is "an essential component of collective learning" and that "managers must actively encourage the development of different and conflicting views" (Fiol, 1994, p. 403).

As was discussed in chapter 2, the sub teams and the MTS in OISDP are teams performing non routine tasks that involve high levels of information processing. The importance of shared knowledge and conflict were discussed in this theoretical chapter as well. As discussed in paragraph 4.2, task related conflict may be a necessity for the sub teams in the MTS to exchange ideas and viewpoints and to build sufficient shared knowledge on the Information System to be built. In addition, the findings show that sub team level task conflict is negatively related to MTS level process conflict which may be explained by the reasoning that more discussion on the content of the task intra sub team reduces

the need for process conflicts in the MTS. That is: if the sub teams have a clear understanding of what they need to do, there is less need for process related discussion on the MTS level.
Sub team level task conflict was found to spillover to MTS level task conflict. Given the knowledge intensive character of the task at hand and the fact that, in order to be successful, client and vendor must have a common understanding of the task (the IS to be built), task conflict on the MTS level can be expected to be a necessity; similar as on the sub team level, the benefits of task level conflict will outweigh its potential negative effects on the MTS level.
On the other hand, the findings show that task conflict has predictive value for relationship conflict, both on the sub team and MTS levels. This supports previous findings that prolonged task conflict transforms into relationship conflict and of people associating task with person (Curşeu & Schruijer, 2010; Hinds & Mortensen, 2005; Mohammed & Ringseis, 2001; Jehn, 1997).

The findings suggest that task conflict in the sub teams should neither be ignored nor avoided. There are expected beneficial effects – both for the sub team as well as for the MTS as a whole. Care should be taken that task conflict does not transform into relationship conflict. For (sub team) project managers, the practical implication is that they should actively manage task conflict within their sub teams in order to balance the expected benefits against the risk.
On the MTS level, task conflict may be a necessity to ensure that client and vendor have the same understanding regarding the IS to be developed.
Task conflicts can be used to energize information and knowledge exchange, whereas finding the signals indicative of state changes from task conflict into relationship conflict – often times in the shape of feedback signals as to task execution and associated behaviors – is a key activity in managing MTSs and their interfaces.

The reported effects of process conflict on team performance in existing research are at least ambiguous. This may have to do with differences in types of teams and levels of interdependency within teams. In my research, I also find different relationships between process conflict and the other conflict types on the different levels (sub team versus MTS).

On the MTS level I found an unpredicted but significant relationship between task and process conflict that was not found on the sub team level. A relationship that may be explained by the fact that at the MTS level task and process domains are more closely intertwined because of the contractually governed formal relationship that delineates tasks and responsibilities.
On the other hand, as I predicted, the sub team level showed significant relationships between process and relationship conflict that were not found on the MTS level. In these inter organizational MTSs, this can be explained by the fact that process conflict to a large degree (for instance with respect to responsibilities) will be dealt with by formal contractual obligations and will be perceived more as organizational than as personal conflict.
The MTS level project or program manager should therefore not only actively balance the expected task conflict benefits against the transformation risk, he or she should also be aware of the more blurred distinction between task and process conflict in order to prevent ineffective discussions and potentially erroneous interventions.

Limitations

Next to its contributions, the current study has several limitations. First, data was collected using the same source, therefore the results are susceptible to common method bias. Second, the data is cross sectional and therefore any causal claim should be avoided. Further research should explore the interplay of task, process and relationship conflict in MTS using longitudinal or in experimental studies. Third, the number of projects used in this study is relatively small – additional research with a larger number of projects could explore the co-occurrence of different conflict types in MTS. Fourth, in this chapter I focused on conflict and its relationships – further studies should look at relationship in conjunction with other variables such as team performance, team processes and team emergent and affective states such as trust and cohesion to provide a more complete perspective on the complexity of MTSs in IS outsourcing. Fifth, I aggregated group and MTS level conflict scores under the homogeneity assumption (individuals in sub groups and MTS should agree on the level of conflict they experience) – future research however should relax this assumption and further explore and test (in larger samples) the effect of conflict asymmetry in MTS on MTS dynamics and performance. As sub teams composing the MTS may differ with respect to their proximal goals, it is not unreasonable to argue that at different performance stages they experience different levels and conflict and this asymmetry may further impact on the whole system dynamics.

4.7 | References

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CHAPTER 5

Emotion Regulation and Conflict Transformation in Multi-Team Systems[9]

[9] This chapter is a slightly modified version of a paper that was published in the International Journal of Conflict Management, Vol. 25, No. 2, pp. 171-188

Abstract

This chapter tests the moderating role of emotion regulation in the transformation of both task and process conflict into relationship conflict. I found that when collective emotion regulation strategies are effective, process conflict is less likely to transform into relationship conflict. An emergent finding of this study shows that process conflict mediates the interaction between task conflict and emotion regulation on relationship conflict in multi-team systems. The main practical conclusions are that managers of multi-team systems should actively try to stimulate their teams to develop effective emotion regulation strategies as effective emotion regulation mechanisms minimize the risk of process conflict transforming into relationship conflicts.

Keywords: multi-team-system, conflict transformation, task conflict, process conflict, relationship conflict, emotion regulation

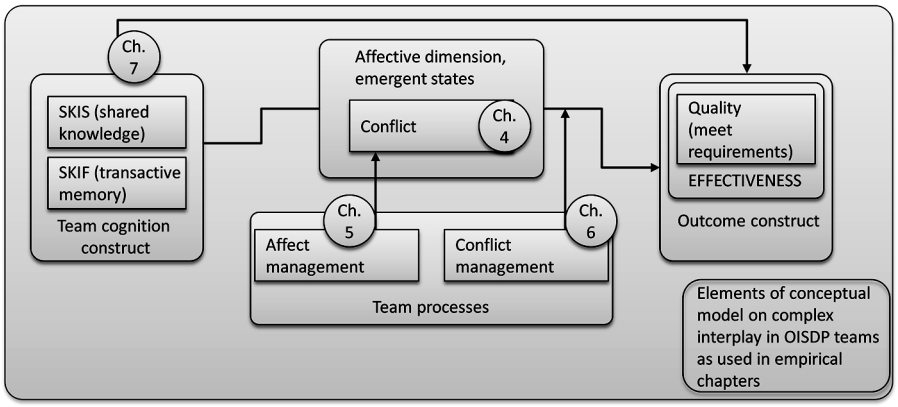

Figure 15 | Positioning chapter 5

5.1 | Introduction

Conflict is inherent in organizations. Intra-group conflict refers to disagreements or perceived incompatibilities among group members and it is a multidimensional and multilevel construct (De Wit, Greer and Jehn, 2012; Greer, Jehn and Mannix, 2008; De Dreu and Weingart, 2003; Jehn, 1995). Intra-group conflict is multidimensional as literature to date distinguishes between several types of conflict (e.g., task, process and relationship, Jehn, 1995) and it is multilevel as the interplay of individual and relational (e.g., dyadic and group) variables play an important role in conflict emergence and transformation (Korsgaard, Jeong, Mahony and Pitariu, 2008).

Conflict types and findings relating conflict to team outcomes and team performance were introduced and described in paragraph 2.3.5. In short: relationship conflict involves interpersonal frictions, task conflict relates to disagreements about (collective) goals and task definition and process conflict reflects disagreements over logistical issues, task distribution and scheduling (Behfar et al., 2011; Greer et al., 2008). Research to date shows that the three types of conflict are (positively) correlated and the dynamic interplay of the three types of conflict has important implications for group performance (De Wit et al., 2012; Greer et al., 2008).

As (negative) emotionality is an important epiphenomenon of conflict (Bodtker and Jameson, 2001), the way in which group members manage these conflict-related emotions becomes critical in conflict dynamics and conflict transformation. Although prior conceptual research has pointed towards the important role of emotional intelligence in conflict transformation (Ayoko, Callan and Hartel, 2008) we have little to no empirical evidence on how emotion regulation strategies influence the transformation of process into relationship conflict. Therefore, the first aim of this chapter is to test the moderating role of emotion regulation in the relationship between task and process conflict on the one hand and relationship conflict on the other hand.

As intra-group conflict emerges from the interplay of individual and relational (within group and between groups) processes (Korsgaard et al., 2008), multi-team systems (MTS) offer great opportunities for exploring conflict transformation as they provide a variety of cross-level dynamics (Mathieu, Marks and Zaccaro, 2001). Because in the ICT industry, Information Systems (IS) development requires knowledge from multiple domains (Crowston & Kammerer, 1998), a growing number of Information Systems are developed by MTSs. MTSs consist of sub teams from both client and vendor organizations and their dynamics is influenced by within as well as between group interaction processes. Understanding the dynamics of conflict in the context of cross-organizational MTSs in outsourced IS development is important because distal goals may be shared by the sub teams in an MTS, proximal goals may not be shared (Mathieu et al., 2001). For example, cost for one sub team (client) is revenue for the other (vendor).

Due to the complex cross-level dynamics unfolding in MTSs, the understanding of conflict transformation is of critical importance for the management of MTSs. In line with a call for more

research on the multilevel dynamic of intra-group conflict (De Wit et al., 2012; Jehn, Rispens and Thatcher, 2010), a second aim of the chapter is to address conflict transformation, using both individual perceptions and aggregated group level conflict scores. Little research was done into conflict in the context of MTSs – this in contrast to conflict research on workgroups and single (as opposed to multi) teams where conflict has shown to be an important factor influencing team performance (Jehn et al., 2010; Greer et al., 2008; Passos & Caetano, 2005; de Dreu & van Vianen, 2001; Jehn & Mannix, 2001; Montoya-Weiss et al., 2001).

This chapter contributes to the literature on intra-group conflict in three ways. First, it explores the conflict dynamics and in particular conflict transformation in a multi-team setting and it furthers our understanding of conflict transformation in organizational settings that involve interpersonal as well as intergroup interactions. Second, it explores the effect of the interaction between process conflict and emotion regulation on relationship conflict and in doing so it answers the call for more research exploring the interplay of process and relationship conflict. Third, it uses a multilevel approach to test the interaction between individual perceptions of conflict and emotion regulation and therefore contributes to the more comprehensive understanding of intra-group conflict as a multidimensional and multilevel construct.

5.2 | Theoretical Background

Recent empirical evidence pointed towards the critical role of emotion regulation in the transformation of task conflict into relationship conflict (Curşeu, Boroş and Oerlemans, 2012). Task conflict however, is less likely to be associated with negative emotionality and negative moods shared by group members, than process conflict (De Wit et al., 2012).

Intra-group Conflict

Ample research discusses the effects of the three types of conflict on team effectiveness, productivity, cohesiveness, commitment and team member satisfaction. Refer to paragraph 2.3.5 for more details. In short:

For relationship conflict, findings typically show that relationship conflict is detrimental to various indicators of team effectiveness (Behfar et al., 2011; Greer et al., 2008; Rau, 2005; Yang & Mossholder, 2004; DeDreu & VanVianen, 2001; Ensley & Pearce, 2001; Jehn & Chatman, 2000; Simons & Peterson, 2000; Jehn, 1997, 1995; Pelled, 1996) and these findings were confirmed in two meta-analyses (de Wit et al., 2012; DeDreu & Weingart, 2003).

The findings on the association between task conflict and team outcomes are inconclusive. Please refer to paragraph 2.3.5 for more details (see task conflict). In short: task conflict has been found to benefit performance (Behfar et al., 2011; Greer et al., 2008; Yang & Mossholder, 2004; Peterson & Behfar, 2003; Ensley & Pearce, 2001; Jehn & Chatman, 2000; Jehn & Mannix, 2001; Simons & Peterson, 2000; Alper et al. 1998; Pelled, 1996; Jehn, 1995) but has also been found to be detrimental to performance (Greer et al., 2008; DeDreu & Weingart, 2003; Simons & Peterson, 2000).

Findings on process conflict so far show a fairly consistent negative impact on team performance (De Wit et al., 2012; Behfar et al., 2011; Goncalo, et al., 2010; Passos & Caetano, 2005; Jehn & Chatman, 2000). But, as with task conflict, process conflict was also found to benefit performance (de Wit et al., 2012; Behfar et al., 2011; Goncalo et al., 2010; Jehn & Mannix, 2001).

Emotions and Conflict Transformation

Recently, the interest in the impact of affective states on conflict transformation and conflict management and the number of empirical studies addressing the relationship between affective phenomena and conflicts has grown (Montes et al., 2012). Chen and Ayoko (2008) researched relationship conflict and emotions, and suggest future research to collect data from professionals and use a multilevel perspective in order to capture the nested nature of individuals in organizations and groups. Nair (2008) argues that emotional states are closely linked to conflict management and resolution strategies and further research should explore the interrelationship of values, emotions and conflict as well as the role of emotion (especially positive emotion) in conflict resolution, and the relationship between conflict management and emotion management. Moreover, Yang and Mossholder (2004) call for more research on the emotional contingencies that impact on conflict transformation.

Bodtker and Jameson (2001) argue that conflict is an emotionally defined and driven process, a statement corroborated by Jordan and Troth (2004) who pose that all conflict (functional or dysfunctional) is inherently emotional because it involves the perception of threats to individual or group goals. Therefore, it is apparent that emotion and emotion regulation strategies underpin many behaviors and attitudes examined in connection with intragroup conflict, and should be treated as more than a byproduct of interpersonal interaction (Yang & Mossholder, 2004; Bodtker & Jameson, 2001; Jehn, 1997).

Prolonged and intense task conflict was found to transform into relationship conflict as a result of people associating task with person (Curşeu & Schruijer, 2010; Mohammed & Ringseis, 2001; Jehn, 1997) and because task conflicts are often misinterpreted as personal attacks, a process of misattribution and taking things personally (Yang & Mossholder, 2004; Simons & Peterson, 2000). In addition, in heated task discussions, people may use harsh language or other tactics that will be perceived as aggressive, leading to hurt feelings and relationship conflict. It can be expected that strong relational ties in a team allow for shared knowledge on interaction patterns and thereby enable shared emotional schemas allowing proper interpretation of others' emotional expressions, reducing misattribution and misperceptions (Yang & Mossholder, 2004). Druskat and Wolff (2001) suggest that the ability to regulate emotions is essential for group effectiveness, especially when a team must work together on a long-term assignment while Yang and Mossholder (2004) argue that group members' emotional processing play a key role in the connections between task and relationship conflict.

Process conflicts may be particularly susceptible to transform into relationship conflict because of the connotations of personal worth and respect that are challenged in process issues and the personal

connotations often carried by the issues at the heart of process conflicts, such as task delegation or role assignment (cf. Greer et al., 2008). In addition, process conflicts may be representative of resource misallocations or inappropriate task assignments to team members (Jehn, 1997). Such conflicts may dramatically affect the way things are done including creating heightened sensitivities, and thus propensities for conflicts (Goncalo et al., 2010; Greer et al., 2008; Jehn & Mannix, 2001).

5.3 | Hypotheses

Literature on emergent collective competencies argues that group emotion regulation is one of the core components of collective emotional intelligence (Jordan & Troth, 2004; Salovey & Mayer, 1990). Building on Yang and Mossholder (2004), Curşeu et al. (2012), argue that group emotional regulation is one of the three dimensions of collective emotional intelligence that refers to the collective process of solving discrepancies between current and desired emotional states experienced by group members; emotion regulation is an emotional control mechanism and if effective it should also block the overt manifestation (i.e., behavioral) of negative emotionality in group settings. According to Barsade and Gibson (1998) collective emotions emerge from individual emotions that are shared within groups through contagion, vicarious learning and behavioral entrainment (emotional adjustment through which group members strive for emotional synergy). Nevertheless, if overt emotional reactions associated with task or process conflict are controlled, the chance that they will be shared and generate a negative group climate decreases and thus conflict transformation is less likely to occur.

The following example from the IS outsourcing MTS illustrates the interplay of conflict perceptions and emotion regulation strategies. The essence of the contractual obligations in outsourced IS development, is developing software by the vendor on behalf of the client given a fixed budget and timeframe. As a consequence, the vendor demands unambiguous and high quality requirements and specifications from the client – a notoriously difficult task. Reality is that specifications need various iterations before a vendor finds them acceptable. This process increases tension since both sub teams are being pressured to move forward. Content focused (cognitive) discussions on specifications increasingly show harsh language, impatience and frustrations on both sides. Often under pressure, disagreements are voiced in emotion-laden language ("These specifications are solid – we really expected much more flexibility from you as a vendor"). Given the tension imposed by fixed budgets, the contradictory proximal goals (income for one is cost for the other), and the constant pressure from the two parent organizations, it is no surprise that people will (re)act emotionally, take things personally and that task or process conflict may be perceived as threats to individual and group goals and eventually transform into relationship conflicts. If a group member experiences task or process conflict and collective emotion regulation strategies are inefficient or nonexistent, the emotions associated with the task or process conflict will be expressed and increase the salience of interpersonal nature of conflict. This will eventually increase the chance of conflict transformation and as a consequence, the group will experience more relationship conflict.

When however the group uses effective emotion regulation strategies, negative emotions experienced by individuals in the group are controlled and as a consequence task and process related disagreements are less likely to generate relational frictions. Therefore, emotion regulation may be the buffer blocking conflict transformation by acting as a behavioral control in interpersonal interactions. Although group members may experience negative emotions associated with task- or process-related disagreements, effective emotion regulation prevents the personification of task and process conflicts and hence their transformation into relationship conflict.

The reason for focusing on emotion regulation as a contingency factor is that previous research on student teams shows that effective emotion regulation strategies prevent task conflict to evolve into relationship conflict (Curşeu, et al., 2012). Although traditionally intragroup conflict was addressed in previous studies as a group level phenomenon (De Dreu & Weingart, 2003), more recent research argued that groups are nested systems and that next to a group level perspective on conflict transformation, individual perceptions should be used to fully understand the dynamics and transformation of within group conflict (Jehn, et al., 2010; Korsgaard et al., 2008). Each member may experience conflict differently and also perceive the other group member's attempts to regulate emotions in a different way, therefore the interplay between these perceptions will eventually effect on the amount of relationship conflict experienced by groups.

***Hypothesis 1**: for groups with higher levels of emotion regulation as reported by individuals, the association between perception of task conflict and team relationship conflict is weaker than for groups with lower levels of emotion regulation.*

***Hypothesis 2**: for groups with higher levels of emotion regulation as reported by individuals, the association between perception of process conflict and team relationship conflict is weaker than for groups with lower levels of emotion regulation.*

5.4 | Method

Data collection and sample that underlie the empirical chapters are described in chapter 3, paragraphs 3.2 and 3.3.

Individual perception of task conflict (iTC), individual perception of process conflict (iPC) and individual perception of emotion regulation (iER) were measured as individual level variables. For iTC and iPC, existing (Jehn & Mannix, 2001) five-point Likert scales (1=not at all; 5=to a great extent) were used. The scales were translated to Dutch and items were back translated to check for translation accuracy. iER was evaluated with an existing 7-item five-point Likert scale (1=strongly disagree; 5=strongly agree) that was developed to evaluate group emotion regulation, and previously used in the Dutch context (Curşeu et al., 2012). All scales used in the research are presented in the appendix. Different from iTC, iPC and iER, the scores for relationship conflict were aggregated on team level

as the average perception of relationship conflict *excluding* the focal individual's perception. This aggregation procedure was previously used in multilevel studies related to work family conflict in groups (Bhave et al., 2010), goal and value congruence in groups (Ostroff et al., 2005; Kristof-Brown & Stevens, 2001), interpersonal aggression (Glomb & Liao, 2003; Robinson & O'Leary, 1998), and intra-group conflict (Pluut & Curşeu, in press). The reliability of the scales as indicated by Cronbach's alpha: .774 for the emotion regulation scale, .895 for relationship conflict, .763 for task conflict and .835 for process conflict.

For relationship conflict (and for the mediation analysis for process conflict), individual scores were aggregated into project-team scores. I computed $r_{WG(J)}$scores (James, Demaree and Wolf, 1984) to check for sufficient within-group agreement. I excluded the teams for which the values were lower than the recommended cutoff point of .70, resulting in 21 projects with 80 respondents. The remaining dataset shows teams with $r_{WG(J)}$values from .77 to .97. Furthermore, I used ANOVA to test between-group variance using 'project-id' as factor (using the combined client/vendor team as the team) and the results indicate that the between-group variance exceeds the within-group variance. For *relationship conflict* $F(20,57)=3.30$; $p < .001$ and for *process conflict* $F(20,57)=3.81$; $p < .001$. Finally, the ICC1 for relationship conflict is .16 and for process conflict is .20. The combination of the results of $r_{WG(J)}$, ICC1 and ANOVA support the aggregation of relationship and process conflict scores to the team level.
I evaluated *task conflict*, *process conflict* at the individual level, representing a focal individual's perception of these types of conflict. Similarly, the individual perception of *emotion regulation* in the team was measured. Team relationship conflict was measured as the average perception of relationship conflict in the team *excluding* the focal individual (for the mediation analysis a similar strategy was used for process conflict). This analytical approach allows for assigning (different) group level scores to each individual in the sample and as a consequence test the impact of individual level variables on group level constructs. Regressing the individual perception variables on team level relationship conflict (with the focal person excluded) allows us to also reduce the common method variance in our analyses (Glomb & Liao, 2003). This analytical procedure captures individual perceptions (since each member may experience conflict differently and also perceive the other group member's attempts to regulate emotions differently) and their impact on relationship conflict as experienced by the other group members. Variables were grand mean centered reducing multicollinearity to acceptable levels but retaining a model equivalent to the raw-score model (Aiken & West, 1991).

5.5 | Results

In Table 17 I report the descriptive statistics (mean, standard deviations), correlation matrix and the reliabilities for the scales. Note that there is significant correlation between the predictors but within an acceptable range and in line with the inter-correlations reported in previous studies (De Wit et al., 2012).

Table 17 | Means, standard deviations and reliabilities for the scales

	Mean	SD	1	2	3	4
1. iER	3.36	.56	(.77)			
2. iTC	2.46	.69	-.558**	(.76)		
3. iPC	2.18	.75	-.528**	.731**	(.83)	
4. GRC (minus the focal person)	2.11	.59	-.388**	.492**	.338**	(.89)

n=80, * p < .05 ** p < .01 *** p < .001
Note: iER – individual perceptions of group emotion regulation, iTC – individual perceptions of task conflict, iPC – individual perceptions of process, GRC – group relationship conflict; Cronbach's alpha is presented in between brackets

In order to test the hypotheses, I regressed task conflict, process conflict and emotion regulation on relationship conflict. Moreover, in order to replicate the results reported in Curşeu et al. (2012), I performed a stepwise regression analysis. In the first step, the individual predictors were entered, in the second and third steps the two-way cross-product terms. In the second step of the analysis I added the cross product term of task conflict and emotion regulation (the effect tested in Curşeu et al. (2012)) and in the third step I added the interaction effect of process conflict and emotion regulation. The results are presented in Table 18 and the regression slopes are depicted in Figure 16, Figure 17.

Table 18 | Results of the stepwise OLS regression analysis

		Relationship Conflict		
Model / Step		1	2	3
1	Individual perception of task conflict (iTC)	.45***	.40**	.44**
	Individual perception of process conflict (iPC)	-.09	-.11	-.16
	Individual perception of emotion regulation (iER)	-.17	-.18	-.18
2	iTC x iER		-.24*	.17
3	iPC x iER			-.48*
	F change	8.72***	5.93*	6.28*
	R^2	.26	.32	.37
	Adj. R^2	.23	.228	.33

* p < .05 ; ** p < .01 ; *** p < .001
Note. iER – individual perceptions of group emotion regulation, iTC – individual perceptions of task conflict, iPC – individual perceptions of process conflict.

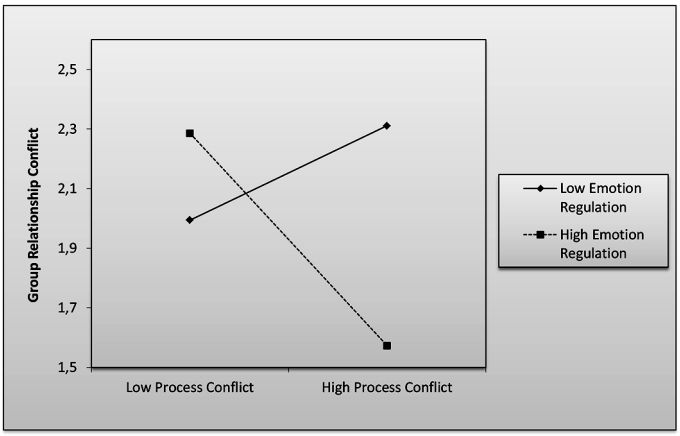

Figure 16 | The effect emotion regulation x process conflict on relationship conflict (model 3)

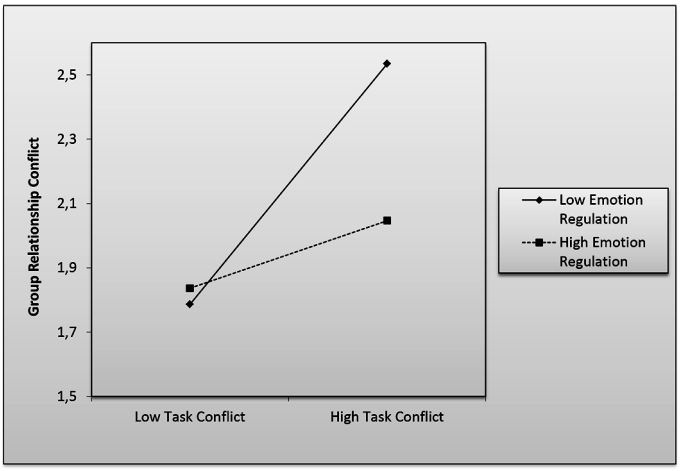

Figure 17 | The effect emotion regulation x task conflict on relationship conflict (model2)

In order to further explore the moderating role of emotion regulation, I conducted a simple slope analysis and used a procedure described in Hayes and Matthes (2009). Using individual perceptions of process conflict as the main predictor, and controlling for individual perceptions of task conflict, the results show that at low levels of emotion regulation (M-1SD) the association between individual perceptions of process conflict on group relationship conflict are positive yet not significant (β=.10, 95% CI [-.13;.35]), at average levels the effect is negative and not significant (β= -.12, 95% CI [-.35;.09]), and at high levels of emotion regulation (M+1SD) the effect of process conflict perceptions on group relationship conflict is negative (β= -.36, 95% CI [-.64;-.08]).

A further analysis using the Johnson-Neyman method reveals that at very low levels of emotion regulation the association between perceptions of process conflict and group relationship conflict is positive and significant. That is: if emotion regulation mechanisms become more effective, the association between the individual perceptions of process conflict and group relationship conflict transforms from positive to negative. Using task conflict as the main predictor, and controlling for individual perceptions of process conflict, the interaction effect of emotion regulation and perceptions of task conflict is significant (β= -.34, p=.01). The results of the simple slopes analysis show that at low levels of emotion regulation (M-1SD) the association between individual perceptions of task conflict and group relationship conflict is positive and significant (β=.52, p=.0003, 95% CI [0.24;0.80]), for average emotion regulation scores, the association is also positive and significant (β=.33, p=.01, 95% CI [.07;.59]), and finally, at high levels of emotion regulation the association between perceptions of task conflict and group relationship conflict is positive yet not statistically significant (β=.14, p=.36, 95% CI [-.17;.47). The OLS results presented in Model 2 as well as the results of the simple moderation procedure as described in Hayes and Matthes (2009) replicate the results reported in Curşeu et al. (2012) showing a significant and negative interaction effect of task conflict and emotion regulation on relationship conflict.

The results indicate that the interaction effect of process conflict and emotion regulation specifies the significant effect of the cross product term between task conflict and emotion regulation. A plausible explanation for this result is that the emergence of process conflict actually mediates the impact of the interaction effect of task conflict with emotion regulation on relationship conflict.
In order to further explore this claim, I conducted a bootstrap analysis using process conflict scores (group mean excluding the focal individual) as a mediator between perceptions of task conflict and emotion regulation on the one hand and group relationship conflict on the other hand.
Following Preacher and Hayes (2004), I used bootstrapping as implemented in the *process models* (Hayes, 2012) to compute the bias-corrected confidence interval (BCCI) of the mediated effect of the highest order interaction, which does not include zero (95% BCCI from -.48 to -.17). As the 95% confidence interval does not include zero, I can conclude that the mediation claim is supported and the results of the mediation analysis are further summarized in Figure 18. We can conclude that group process conflict mediates the effect of the interaction between task conflict and emotion regulation on relationship conflict.

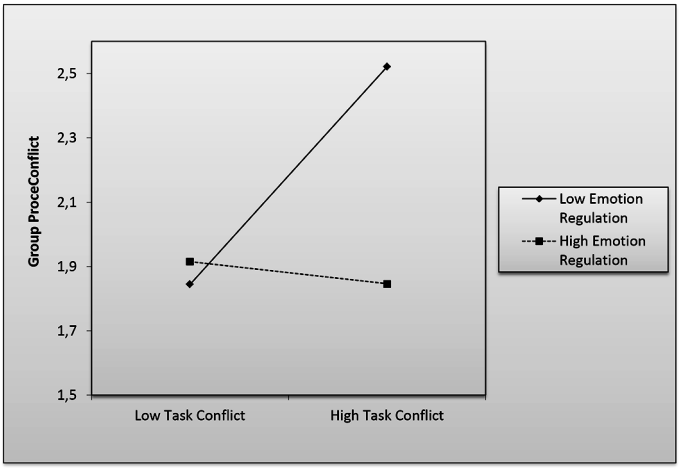

Figure 18 | The effect of emotion regulation x task conflict on group process conflict

During hypotheses testing, I found unexpected, emergent, results that suggested an even more complex relationship in that the moderated effect that individual perception of Task Conflict has on Group relationship conflict (with individual perception of Emotion Regulation as moderator) might be mediated by (group) process conflict. Testing of such complex relationships is possible using the Hayes (2012) bootstrapping procedures. The Hayes' (2012) software package presents a number of heuristic strategies to test complicated models; 'model 8' allows for testing mediation of a moderated effect. Hayes' output offers the separate regression analyses.

To summarize, an interpretative picture of the findings is depicted in Figure 19. The picture is a summary of the results and shows the direct and indirect effects; the details can be found in paragraph 5.8.

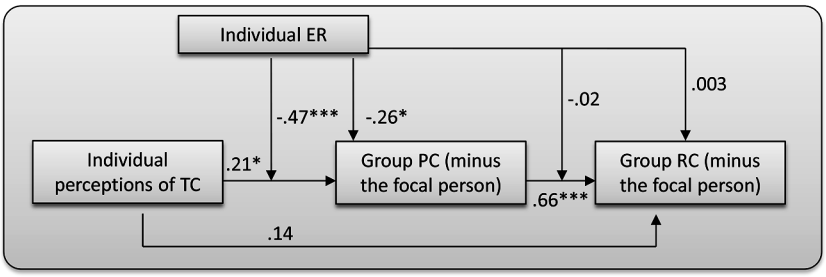

Figure 19 | Overview of the mediation analysis results for relationship conflict

Note. PC= process conflict, RC=relationship conflict, TC=task conflict

* p < .05, **p < .01, ***p < .001;

Table 19 | Mediation by process conflict

	Emotion regulation	Effect	Boot	SE	BootLLCI
Process conflict	-.5363	.3122	.0738	.1803	.4707
Process conflict	.0150	.1390	.0701	.0084	.2891
Process conflict	.5663	-.0341	.0912	-.2087	.1584

Table 19 contains part of the Hayes' (2012) output that can be found in paragraph 5.8. The table shows that at low levels of emotion regulation, the association between task conflict and relationship conflict mediated by process conflict is positive and significant; at medium levels of emotion regulation, the association is still positive (but less so) and significant whereas at high levels of emotion regulations, the effect becomes insignificant. This suggests that the emergence of process conflict may explain the joint effect of task conflict and emotion regulation on relationship conflict.

Because the results of the OLS are likely to be influenced by endogeneity (members in the same group are likely to report similar levels of conflict) and because individuals are nested in groups I conducted a supplementary multilevel analysis. Results of previous studies (confronted with similar constraints) that used in combination OLS and HLM show that the two analytical procedures yield highly similar results (e.g., Liao & Chuang, 2007; Glomb & Liao, 2003). The results of the multilevel analysis are presented in Table 20. As illustrated in Table 17 and Table 18 the two methods yield highly consistent results supporting the significant effect of the interaction between emotion regulation and process conflict (as evaluated by each individual member in the group) on relationship conflict (average group level conflict excluding the focal person's evaluation).

Table 20 | Results of the Multilevel Analysis for Group Relationship Conflict

Group Relationship Conflict			
	B (SE)	t(sig)	95% CI
Individual perception of task conflict (iTC)	.17 (.06)	2.85 (.006)	[0.05, 0.30]
Individual perception of process conflict (iPC)	.01 (.06)	.27 (.78)	[-0.10, 0.13]
individual perception of emotion regulation (iER)	-.12 (.05)	-2.23 (.02)	[-0.23, -0.01]
iTC x iER	.16 (.11)	1.43 (.15)	[-0.06, 0.39]
iPC x iER	-.22 (.10)	-2.05 (.04)	[-.43, -.004]
ρ		.16	
R^2_1		.17	
R^2_2		.01	

Note: iER – individual perceptions of group emotion regulation, iTC – individual perceptions of task conflict, iPC – individual perceptions of process conflict.

The OLS results presented in Model 3 (Table 18) as well as the results of the multilevel analysis presented in Table 20 support the hypothesis that emotion regulation moderates the effect of perceptions of process conflict on relationship conflict, but they do not fully support the hypothesis that emotion regulation moderates the effect of task conflict on relationship conflict.

5.6 | Discussion and managerial implications

This study extends the insights on conflict transformation in teams in several ways. First, the study contributes to the literature on intra-group conflict by investigating the interplay of task, process and relationship conflict in a real-world multi-team systems setting. I investigated the interplay between individual perceptions of task and process conflict, their potential transformation into team relationship conflict and the moderating role that emotion regulation plays in this transformation. In doing so, in a MTS setting I built on the previous insights showing that emotion regulation is an important contingency in conflict transformation (Curşeu et al., 2012). Second, I show that emotion regulation moderates the effect of process conflict on relationship conflict. Finally, the findings show that the emergence of process conflict in teams explains the joint effect of task conflict and emotion regulation on relationship conflict. This result is in line with a longitudinal study on conflict transformation in which Greer et al. (2008) showed that process conflict management has a crucial role in conflict transformation.
In particular this study shows that effective process conflict management in the initial stages of group development reduces the strength of the association between task and relationship conflict in later stages of group development. Another relevant result shows that process conflict in the initial stages of group development was the only significant predictor for the other types of intra group conflict reported at later stages of group development. This result points towards the fact that the emergence of process conflict could in fact explain the effect of the interaction between task conflict and emotion regulation on relationship conflict in a temporal way. The mediation analyses in this chapter support this claim and show that indeed group process conflict mediates the joint impact of task conflict and emotion regulation on the emergence of relationship conflict. Task related disagreements may push the groups to engage in debates and disagreements related to task allocation and distribution of responsibilities, which in turn generate relational tensions and conflicts. My analysis also shows that perceptions of task related disagreements lead to group process conflict especially when emotion regulation mechanisms are not effective.

A plausible explanation for the critical role of process conflict resides in the research context in which I carried out the study. The deliverables of the sub teams composing the MTS are prescribed by contractual agreements and clear procedures are specified. Therefore, given these contractual agreements, when process conflict emerges (that is: when members experience disagreement with respect to role distribution, task delegation and assignment), emotion regulation is crucial to prevent conflict transformation. If emotion regulation is effective in reducing the negative emotions associated with process conflict, it will most likely reduce the negative emotionality associated with

task conflict. Further research should explore the co-occurrence of negative emotions with task and process conflict and the way in which emotion regulation reduces these negative emotions. In this way, research could disentangle the association of task and process conflict with negative emotionality and further clarify the implication of collective emotional competencies (e.g., emotion regulation) in conflict transformation.

Limitations

Next to its contributions, the current study has several limitations. First, the sample size is rather small. By using the analytical methods described in the instruments section, this limitation is mitigated to a certain degree. Nevertheless, the sample size suggests that additional (lab-) research with larger samples is recommended in order to further substantiate the presented findings. Although the dataset contains information over project stages performance episodes, the relatively small sample size did not allow me to utilize these performance episodes. It is therefore not possible to make any temporal or causal claims. Second, data was collected using the same source, therefore the results are susceptible to common method bias. I corrected for this problem in the way I built the regression model. The dependent variable aggregates the evaluation of other team members and this could in fact be considered an independent source. Moreover, according to Evans (1985) common method bias is less of a problem when testing interaction effects as I do here. Third, the data is cross sectional and therefore any causal claim should be avoided. Further research should explore the interplay of task, process and relationship conflict in longitudinal or in experimental studies.

Theoretical contributions and future research directions

Following up on calls to further investigate the relationships between conflict-types and emotion (Curşeu et al., 2012; De Wit et al., 2012; Yang & Mossholder, 2004), and to extend understanding of intra group conflict as a multilevel phenomenon (Korsgaard et al., 2008) I used real world software development teams to test hypotheses on the moderating effect of emotional regulation on conflict transformation. Findings show that emotion regulation does indeed moderate the transformation of process into relationship conflict and contributes to the understanding of intra group conflict as a multilevel and multidimensional construct. As I investigated established groups, it is likely that they used both antecedent and response focused emotion regulation strategies (Curşeu et al., 2012), yet future research should disentangle the role of these two types of emotion regulation on conflict escalation and conflict transformation. Moreover, different types of disagreements experienced by teams may trigger qualitatively different emotions and as a consequence emotion regulation strategies used in teams should be explored in relation to these specific emotions that emerge from interpersonal interaction. Future research on the cross-level dynamics of conflict should go beyond individual and group level and further on explore the role of inter team dynamics (element essential in MTS dynamics) in conflict escalation and conflict transformation. Finally, the findings show that the emergence of process conflict mediates the impact of the interplay between task conflict and emotion regulation on relationship conflict. Research could further explore conflict transformation using a multilevel perspective in longitudinal designs.

Practical implications

This research has a few important implications for conflict management in organizational groups. First group members should be made aware that emotion regulation strategies impact on the way their perceptions of conflict are likely to generate relationship conflicts in the group. This suggests that group members could effectively use emotion regulation (as a control mechanism) to prevent conflict transformation. Therefore, group members should be aware that effective emotion regulation strategies have conflict resolution potential. The results also suggest that managers should be aware of this effect and invest in emotional regulation in their teams. In particular, managers may use normative interventions to train groups in the collective emotion regulation.

Druskatt and Wolff (2001) define emotionally intelligent norms as the attitudes and behaviors that eventually become habits and that benefit groups and teams. Normative interventions are the actions taken to enforce adherence to such norms. Examples include mechanisms for pointing out unwanted behavior, validating members' positive behavior, reminding members of the positive group goals (inspired by Druskat and Wolff (2001). Previous research showed that simple normative interventions are effective ways of achieving synergic effects in (established) groups (Curşeu & Schruijer, 2012). Normative interventions could be used to help the groups develop their collective cognitive competencies. As argued by Yang and Mossholder (2004) groups can also develop affective collective competencies and collective emotional intelligence emerges from interpersonal interactions. Normative interventions focused on emotion regulation strategies could help the groups develop these collective emotional competencies that eventually help groups to block the transformation of task and process conflicts into relationship conflict. Druskat and Wolff (2001) offer a comprehensive framework for developing such emotion regulation norms in groups. Their framework focuses on establishing ground rules for confronting (e.g., Errant interpersonal behavior displayed by group members should be openly discussed), caring (e.g., Support group members when they experience negative feelings), creating resources for working with emotions (e.g., Create fun ways to relieve negative emotionality and stress) and creating an affirmative environment (e.g., Focus on problem solving and not blaming) (Druskat & Wolff, 2001). Such norms may help the groups to better control and manage conflict transformation and escalation.

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5.8 | Tables & Figures

Testing of mediated moderating effect – data underlying Figure 19. The highlighted numbers are represented in the figure.

Table 21 | Hayes model-8 output for mediated moderation

Run MATRIX procedure:
**************** PROCESS Procedure for SPSS Beta Release 130612 ****************
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

****

Model = 8
Y = RelCfl_E
X = i_TaskCf
M = ProcCfl_
W = i_RegulE

Sample size
77

****

Outcome: ProcCfl_

Model Summary

R	R-sq	F	df1	f2	p
.6129	.3757	14.6419	3.0000	73.0000	.0000

Model

	coeff	se	t	p
constant	2.0325	.0636	31.9601	.0000
i_TaskCf	.2167	.1006	2.1554	.0344
i_RegulE	-.2688	.124	-2.1633	.0338
int_1	-.4735	.1365	-3.4703	.0009

Interactions:

int_1	i_TaskCf	X	i_RegulE

****

Outcome: RelCfl_E

Model Summary

R	R-sq	F	df1	df2	p
.7763	.6027	27.3059	4.0000	72.0000	.0000

Model

	coeff	se	t	p
constant	.7037	.1931	3.6451	.0005
ProcCfl_	.6631	.0918	7.2267	.0000
i_TaskCf	.1385	.0813	1.7029	.0929
i_RegulE	.0037	.1005	.0368	.9707
int_2	-.0216	.1155	-.1871	.8521

Interactions:

int_2 i_TaskCf X i_RegulE

********** DIRECT AND INDIRECT EFFECTS **********

Conditional direct effect(s) of X on Y at values of the moderator(s)

i_RegulE	Effect	SE	t	p
-.5363	.1500	.0959	1.5642	.1221
.0150	.1381	.0815	1.6941	.0946
.5663	.1262	.1105	1.1427	.2569

Conditional indirect effect(s) of X on Y at values of the moderator(s)

Mediator

	i_RegulE	Effect	Boot SE	BootLLCI	BootULCI
ProcCfl_	-.5363	.3122	.0738	.1803	.4707
ProcCfl_	.0150	.1390	.0701	.0084	.2891
ProcCfl_	.5663	-.0341	.0912	-.2087	.1584

Values for quantitative moderators are the mean and plus/minus one SD from mean

****

Indirect effect of highest order interaction

Mediator

	Effect	SE(Boot)	BootLLCI	BootULCI
ProcCfl_	-.3140	.0803	-.4869	-.1748

```
********************* ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
1000

Level of confidence for all confidence intervals in output:
95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
3

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = Relationship Conflict of group minus focal individual
- X = Individual Perception of Task Conflict
- M = Process Conflict of group minus focal individual
- W = Individual Perception of Emotion Regulation

5.9 | Appendix

Scales used in the study (translated).

Relationship conflict
How much relationship tension is there in your workgroup?
How often do people get angry while working in your group?
How much emotional conflict is there in your workgroup?

Task conflict
How much conflict of ideas is there in your work group?
How frequently do you have disagreements within your work group about the task of the project you are working on?
How often do people in your work group have conflicting opinions about the project you are working on?

Process conflict
How often are there disagreements about who should do what in your work group?
How much conflict is there in your group about task responsibilities?
How often do you disagree about resource allocation in your work group?

Emotion regulation
Criticism was sometimes thrown without consideration for people's feelings. (rev)
We made each other feel better when we were down.
It was difficult to calm down quickly when we got mad at each other. (rev)
The group was generally able to influence how individual members felt.
We complimented each other when we did something well.
We generally had a good control of our emotions.
When we experienced positive emotions, we knew how to make them last.

CHAPTER 6

Conflict and Conflict Management in Outsourced Information Systems Development Teams: A Multilevel Dynamic Model

Abstract

In this chapter, I empirically investigate multilevel conflict dynamics, their effects on the quality of IS development project team output, and I discuss spillover effects and the effect of Multi-team system (MTS) level conflict management behaviors on these spillover effects. Finally, I lay a brief theoretical foundation that links conflict in these teams to shared knowledge, suggesting that task and process conflict are symptoms of insufficient shared knowledge in teams. My findings show that task and process conflict impact the quality of team output and that cross level mediation and moderation effects exist between task and process conflict and conflict management behaviors. The main practical implications are that managers should be aware that in the early phases of MTS IS development projects, task and process conflict are a necessity to build sufficient shared knowledge for the MTS to be successful; they should manage these conflict types actively to use them to benefit team performance. In later stages of projects, managers might consider task and process conflict as a signal of insufficient shared knowledge and act accordingly. In the multi level context of MTS's, sub team managers must be aware that conflict avoidance in their sub teams may negatively influence overall MTS performance by spillover effects and apply appropriate conflict management styles to prevent these negative effects.

Keywords: Multi-team System, task conflict, process conflict, conflict management behavior

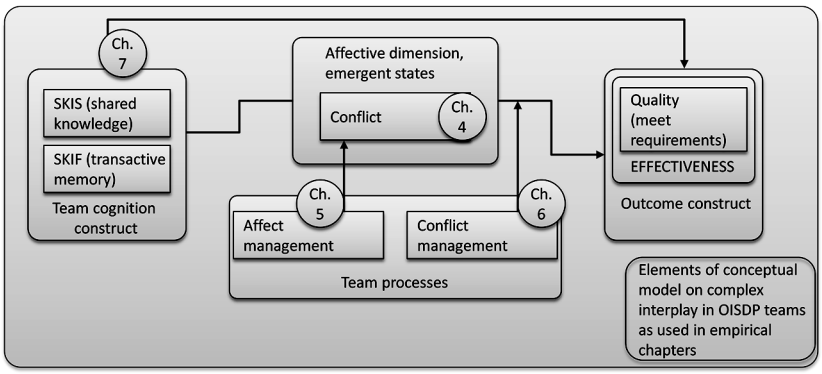

Figure 20 | Positioning chapter 6

6.1 | Introduction

Information System (IS) development requires knowledge and expertise from different domains since the work typically involves complex, dynamic, and unstructured tasks (He et al., 2007; Crowston & Kammerer, 1998). Increasingly, organizations use external vendors to build their Information Systems (IS development outsourcing); that is: information systems are developed by cross organizational Multi-team systems by means of Outsourced Information System Development Projects (**OISDP**s). Understanding the dynamics of conflict in the context of cross-organizational MTS's in outsourced IS development is important because distal goals (Mathieu et al., 2001) may be shared by the sub teams in an MTS, proximal goals may not be. As a consequence, conflict is more likely to occur in these cross organizational MTSs than in team settings in general. Savolainen et al. (2011) explain that when software development is outsourced to an external vendor, there are by definition two parties involved. And although it is often assumed that success is the same for both parties, reality is that success means different things to the customer and the vendor (Savolainen et al., 2011); whereas the aim of the customer is to minimize the costs of the project, the aim of the vendor is to maximize the profit (Savolainen et al., 2011). It is those diverging goals that clearly increase the potential for inter organizational and inter sub team conflict.

Conflict in an IS development outsourcing arrangement is especially problematic, given the complexity of technology, the level of detail in many contracts, the sometimes disparate goals of the parties and the risk of a self-reinforcing vicious cycle (Sabherwal, 1999). Conflicts need to be solved, either cooperatively or in a competitive fashion. Conflict resolution indeed is found to be positively related to relationships (Goles & Chin, 2005; Lee & Kim, 1999; Kern, 1997).

The way in which conflicts are resolved has implications for relationship success, not only in interorganizational relationships in general but in outsourcing relationships in particular (Lee & Kim, 1999; Kern, 1997). This may be attributable to the benefits of constructive conflict resolution, which include more effective communication between the parties, an opportunity to learn from past actions, and the potential to improve productivity and efficiency (Dwyer et al., 1987). Due to the complex cross level dynamics, understanding conflict is of critical importance for the management of MTSs. As previous research did not explicitly address such dynamics, I researched the interaction between team performance, conflict and conflict management styles.

Conflict management in the context of outsourced IS development, can be considered a critical process. Besides having a number of mutual goals (such as successful completion of the software development endeavor), the client and vendor organizations will always have their own goals and objectives that are not in sync with each other (please refer to paragraph 1.1 for an introduction of dilemma 2 on conflict and goals). A certain level of apprehension regarding acting opportunistically is unavoidable. Even if only for this reason, some level of conflict is unavoidable and managing and resolving it is of critical importance. An example in outsourced software development projects is the notion of 'additional work': no matter how extensive the formal contract, there will always be

areas or topics that cannot be predicted or that are not clear-cut and are subject to interpretation regarding whether specific tasks or deliverables are part of the fixed price contract or not. The vendor will show a natural (and opportunistic) tendency to claim that these tasks are not (leading to additional work and revenue) whereas the client will show the opposite tendency (and claim that the elements under discussion are part of the contract and hence will not lead to additional costs).

In this chapter I will further investigate the interplay between conflict, conflict management styles and team performance in a multi team, multilevel context. The purpose is to increase both theoretical knowledge and to derive practical managerial insights into successfully managed client/vendor IS development teams. The chapter contributes to the literature on IS development and conflict in various ways. First, I explore the conflict dynamics and in particular multilevel aspects of conflict and conflict management style. Second, I explore the effect that the interaction between conflict on the sub team level and conflict management on the MTS has on the levels of conflict in the MTS.

6.2 | Theoretical background

Information systems development research concludes that being on time, being within budget, and meeting requirements are unanimously accepted criteria for measuring the performance of development teams. Team performance in software development is covered by two indicators: efficiency and effectiveness (Ryan & O'Connor, 2013; Faraj & Sproull, 2000). Efficiency then refers to the budget and schedule of the project whereas effectiveness refers to the achievement of project goals (Ryan & O'Connor, 2013). Similarly, in MTS research by Hoegl et al. (2004), team performance is defined as a multi-dimensional construct focusing on: quality (technical properties), adherence to budget (costs), and adherence to schedule (time). In this research, I refine the quality criteria to take into account the specific context of cross-organizational MTS.

Conflict

Conflict types and findings relating conflict to team outcomes and team performance were introduced and described in paragraph 2.3.5. In short: relationship conflict involves interpersonal frictions, task conflict relates to disagreements about (collective) goals and task definition, and process conflict reflects disagreements over logistical issues, task distribution and scheduling (Behfar et al., 2011; Greer et al., 2008).

Conflict Management Styles

Previous research explored various types of conflict management approaches and behaviors. For instance, DeDreu and van Vianen (2001) describe various conflict management categorizations based on previous literature. Their listing includes: *cooperative responses, competitive responses, and avoiding.* Rahim (2002) references different authors and provides a number of categorizations including (a) *domination, compromise, and integration*, (b) *forcing, withdrawing, smoothing, compromising, and problem solving*; (c) *integrating, obliging, dominating, avoiding, compromising*.

This latter list is also found in Montes et al. (2012) and Nair (2008) and is based on previous work by Blake and Mouton as is a very similar list by Montoya-Weiss et al. (2001) who suggest *avoidance, accommodation, competition, collaboration, and compromise*. Avoidance behavior is described as evasive, passive and apathetic; Accommodation behavior shows an obliging concern for others; Competitive behavior focuses on own interest without regard for others; Collaboration behavior wants to achieve outcomes that integrate the interests of all parties; Compromise behavior works toward settling on some middle ground. Montoya-Weiss et al. (2001) suggest that both avoidance and accommodation are negative conflict management behaviors because they suggest passive involvement.

Indeed, findings by Montoya-Weiss et al. (2001) show a negative relationship between avoidance behavior and team performance. Jehn (1995) found a positive relationship with team satisfaction. However, neither Montoya-Weiss et al. (2001) nor DeDreu and Vianen (2001) find support for the expected negative relationship between accommodating behavior and team performance. Collaborative behavior was found to be positively related to team performance by DeDreu and Vianen (2001) and by Montoya-Weiss et al. (2001).

Team Cognition

Team cognition has been suggested as a critical mechanism for facilitating knowledge activities in IS literature (He et al., 2007; Faraj & Sproull, 2000; Kraut & Streeter, 1995). It is reported that IS development projects often fail because of coordination breakdown and insufficient knowledge exchange resulting from ineffective communication among team members (Hsu et al., 2012). Without such team cognition, efficient sharing of knowledge, coordination and conflict resolution will not be possible (He et al., 2007; Cannon-Bowers & Salas, 2001; Hollingshead, 2001).

Team mental models (TMMs) are defined as team members' shared, organized understanding and mental representation of knowledge or beliefs about key elements of the team's relevant environment (Wildman et al., 2012; Mohammed et al., 2000, p. 125). TMMs are sometimes referred to as Shared Mental Models (SMMs). Researchers typically distinguish between task and team mental models. Shared task mental models suggests that team members hold a common schema regarding their tasks and the potential role that the broader environment and technology may play (Hsu et al., 2011); shared team mental models represents a shared understanding among team members about how they will interact with one another – including full team interaction and teammate roles (Hsu et al., 2011).

I suggest that in an OISDP MTS, task related knowledge refers to the information system to be developed. I refer to this type of shared knowledge as **SKIS** – Shared Knowledge on the Information System. Team related knowledge refers to knowledge regarding who knows what and knowledge regarding the client/vendor cross organizational interface. I refer to this type as **SKIF** – Shared Knowledge on the InterFace. Please refer to paragraph 2.5.1 for more details on SKIS and SKIF.

6.3 | Hypotheses

This research is based on the underlying framework that was introduced in paragraph 2.4.3 (see Figure 9) and that combines team processes with cognitive and affective emergent states to further clarify the complex dynamics of MTS OISDPs. My model suggests that shared knowledge is a prerequisite for OISDP success. More specifically – that OISDPs require sufficient levels of task related shared knowledge (SKIS) and of team and process related shared knowledge (SKIF). A distinction corroborated by research in the field of shared knowledge and shared mental models including Wildman et al. (2012), Hsu et al. (2011), Mohammed et al. (2010), Cannon-Bowers and Salas (2001), Mohammed et al. (2000).

Previous research has shown that process conflict and task conflict have inconsistent effects on outcomes; both negative and positive effects were found. Task and process conflict can be considered signals that show insufficient shared knowledge. More precisely: task conflict is a symptom of insufficient shared task related knowledge (SKIS) and process conflict is a symptom of insufficient team and process related knowledge (SKIF). As a consequence, higher levels of task and process conflict will be related to lower team performance. I expect higher levels of task and conflict process will be negatively associated with (a) quality – previously defined as the technical properties of the Information System to be built, (b) adherence to budget (costs), and (c) adherence to schedule (time).

In this research, I refine quality criteria to take into account the specific context of cross-organizational MTS: in order to develop the 'right' information system a sufficient level of shared knowledge on the system to be built is a prerequisite. Various studies indicate that one of the reasons behind IS development failures is the lack of knowledge sharing in teams (Xiang et al., 2013; Staples & Webster, 2008); other research has shown that knowledge sharing among project team members is crucial for project performance (Han & Hovav, 2013). He et al. (2007) suggest that shared task understanding is a critical element in IS development teams since people working on a software project need to develop a common view of relevant development issues (He et al., 2007). Without sufficient shared knowledge on the task (SKIS), a development team cannot develop the 'correct' system. To develop a sufficient level of SKIS, discussion on the Information System to be built is a necessity in order to exchange ideas and information.

In group literature task conflict is defined as *divergences on task definition* (Jehn, 1995) and as *awareness of differences in opinions pertaining to the team's task* (Jehn & Mannix, 2001). Korsgaard et al. (2008) describe three main causes of conflict in working environments: scarce resources, divergent values, and the need for cognitive consistency. They further claim that each of these gives rise to a unique form of conflict (process, relationship, and task respectively) (Korsgaard et al., 2008) and that these conflict types confound conflict as a consequence with its causes. Following their reasoning, I separate cause from effect by suggesting that as long as the MTS members diverge on the definition of the task (i.e. experience a need for cognitive consistency), they will need to further

invest in building up SKIS: task conflict (differences in opinions on the task) signals insufficient SKIS and that higher levels of Task Conflict are indicative of lower levels of SKIS. Since a sufficient level of SKIS is a prerequisite for building the correct system, it follows that higher task conflict signals a situation in which a high quality Information System cannot be built. That is: higher Task Conflict will be associated with lower Quality (defined previously as technical quality of the IS).

***Hypothesis 1**: Task conflict on the MTS level is negatively associated with Quality on the MTS level.*

In chapter 4, I investigated and found intra conflict domain spillover effects from sub team to MTS. Task conflict was introduced and defined in paragraph 2.3.5. In OISDP MTS sub teams, each of the sub teams has various types of tasks; tasks that are related to the overall project goals – such as building the required Information System – but also tasks that secondary or administrative in nature and that may be more sub team (or parent organization) focused – such as financial reporting or progress reporting towards the sub team's parent organization. In short: primary (end goal) tasks and secondary (not directly end goal related) tasks. Both of these types of tasks can be subject to task conflict within a sub team but their effects will be different. Sub team task conflict related to the primary task can be expected to negatively impact overall quality since this type of conflict signals insufficient SKIS. On the other hand, sub team internal task conflict on for instance financial progress reporting to the sub team's parent organization is less likely to impact quality of the IS to be built (overall quality). I therefore expect to find that task conflict on the sub team level is negatively related to MTS level quality but only for primary task related task conflict; task conflict that, if not resolved on the sub team level, will spillover to the MTS level since a sub team experiencing primary task related conflict cannot perform its primary task successfully. If a sub team experiences (primary) task conflict – a signal for insufficient shared knowledge on the task – it seems inevitable, as supported by findings, that the discussions on task content are elevated to MTS level and as such lead to task conflict on the MTS level. My findings supported these spillover effects. Secondary task related sub team conflicts are not likely to spill over to the MTS and are not likely to impact overall quality. I therefore suggest:

***Hypothesis 2**: Task Conflict on the sub team level is negatively related to Quality in the Multi-team system. This relationship is mediated by Task Conflict on the Multi-team system Level.*

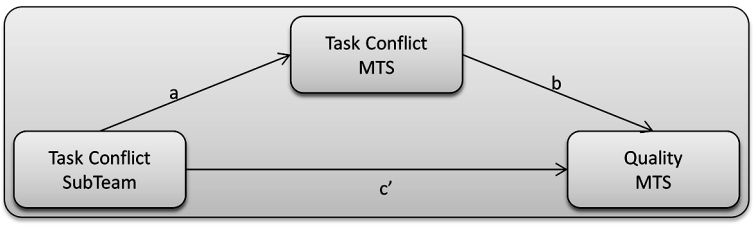

Figure 21 | Mediated Multilevel spillover task conflict

I would expect the spillover effect to be moderated by the level and style of conflict management in the MTS. Given the fact that the MTS consists of client and vendor sub teams, conflict management approaches focusing on jointly solving conflicts can be expected to reduce the spillover effects whereas other conflict management approaches will not reduce (or even increase) conflict on the MTS level. This reasoning suggests that I expect that *avoiding* conflict in the MTS will be associated with *higher* spillover since the conflict is not being dealt with and will fester. *Accommodating* conflict behavior generally is considered a negative and passive approach. However, this categorization is focused on the relationship between accommodating behavior and team performance. The hypothesis focuses on the multilevel spillover effect from sub team to MTS and from that perspective, I expect that accommodating behavior will *reduce* MTS level conflict – by obliging, the conflict in essence remains within the sub team(s).
For *competing* behavior, I would expect that the spillover effect increases whereas for the cooperative styles (*collaborate and compromise*), I expect that high levels of these behaviors in the MTS will *reduce* the spillover effect. These assumptions are summarized in hypothesis 3 below.

Hypothesis 3

The multilevel spillover from sub team level Task Conflict to MTS level Task Conflict is moderated by MTS level conflict management; the moderation effect depends on the conflict management style used at the MTS level and is described in the table below.

Table 22 | Moderation, conflict management, task conflict

	MTS level conflict management style	Moderation effect of MTS conflict management style on spillover from Sub team Task conflict to MTS level task conflict
3a	Avoid	I expect that higher levels of avoiding conflict management in the MTS will be associated with ***higher*** spillover from sub team to MTS level task conflict.
3b	Accommodate	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level task conflict to MTS level task conflict
3c	Compete	I expect that higher levels of accommodating conflict management in the MTS will ***increase*** the spillover effect from sub team level task conflict to MTS level task conflict
3d	Collaborate	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level task conflict to MTS level task conflict
3e	Compromise	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level task conflict to MTS level task conflict

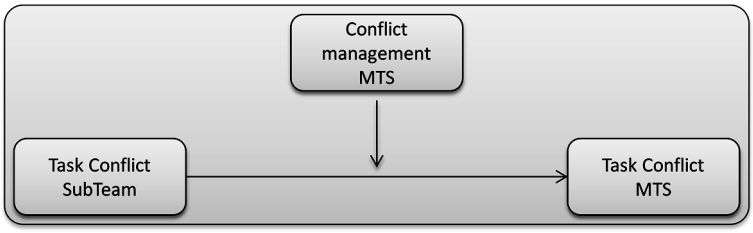

Figure 22 | Moderated Multilevel Task conflict and conflict management

The discussion on Task Conflict and SKIS has a parallel in Process Conflict and SKIF. In order to deliver high quality of work, it is relevant to have shared knowledge on aspects such as responsibilities, how to exchange information between team members, whom to ask questions, both within and between sub teams. I posit that SKIF is the mechanism that supports effective and efficient coordination in the context of outsourced IS development.

Awareness of expertise location is an important element of team cognition in software development teams (He et al., 2007, page 264), and plays a key integrative and coordinative function (He et al., 2007; Faraj & Sproull, 2000). Transactive Memory Systems theory indicates that effective information exchange requires team members to know who possesses what knowledge, to trust the knowledge that one possesses, and to be able to access the knowledge (Hsu et al., 2012; Lewis, 2004). SKIF represents transactive memory and can facilitate team processes to be more efficient and effective (Hsu et al., 2011; Mathieu et al., 2005). In addition, team members with a better understanding of how to interact should be able to effectively exchange and utilize the information collectively held by the group (Hsu et al., 2011).

Furthermore, SKIF allows for specialization. Specialization can reduce the repetition of effort, enabling better access to a wide range of expertise (Austin, 2003; Hollingshead, 2001), which is critical to support the underlying OISDP drivers of cost and specialization. Transactive memory systems contribute to project team performance through two principal paths. Collective tasks or problem solving requires complementary knowledge possessed by different team members. '*TMS enhances the team's ability to bring a greater amount of knowledge at group level to bear on ISD tasks when needed.*' (Hsu et al., 2012). In addition, team members with a better understanding of how to interact should be able to effectively exchange and utilize the information collectively held by the group (Hsu et al., 2011). To develop a sufficient level of SKIF, briefing and discussing these topics is a necessity to exchange ideas and to learn about responsibilities.

As long as MTS members disagree on such issues as role assignments and responsibilities, they will need to further invest in building up SKIF. In literature *disagreements on role assignment and other issues related to how the task is going to be accomplished* (Jehn, 1995) and *an awareness of*

controversies about the how of task accomplishment including issues of responsibilities and 'who should do what' (Jehn & Mannix, 2001) are used as definitions of process conflict.
Moreover, from the three types of intra group conflict, process conflict is the only type that can 'hide' implicit power struggles. Passive resistance towards open manifestations of power often takes the form of process disagreements; when group members disagree about logistic and scheduling issues, these disagreements reflect deeper relational frictions and misunderstandings that cannot be surfaced in the open group debates and that can be expected to negatively impact the quality of the work that needs to be accomplished.

Hypothesis 4: *Process conflict on the MTS level is negatively associated with Quality on the MTS level.*

As with SKIS and task conflict, discussed leading up to hypothesis 2, conflict on role assignments and responsibilities can be related to MTS level roles and responsibilities or to sub team internal issues. Here as well, I expect that the sub team internal issues are less likely to influence overall quality. I therefore suggest that process conflict related to MTS level roles and responsibilities signals insufficient SKIF and that higher levels of Process Conflict are indicative of lower levels of SKIF. From this logic, it follows that I expect that higher Process Conflict signals that SKIF is not yet sufficient and will therefore be associated with lower Quality.

Hypothesis 5*: Process Conflict on the sub team level is negatively related to Quality in the Multi-team system. This relationship is mediated by Process Conflict on the Multi-team system Level.*

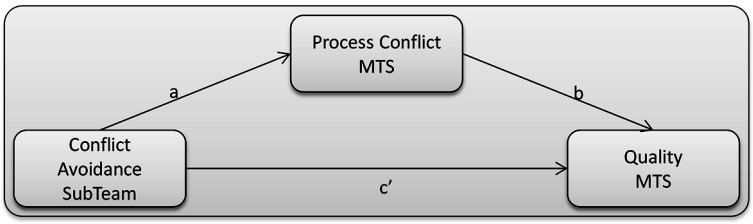

Figure 23 | Mediated Multilevel spillover process conflict

Similar to the situation with task conflict, here as well I expect a moderating effect of conflict management styles on the MTS level.

Hypothesis 6
The multilevel spillover from sub team level Process Conflict to MTS level Process Conflict is moderated by MTS level conflict management; the moderation effect depends on the conflict management style used at the MTS level and is described in the table below.

Table 23 | Moderation, conflict management, process conflict

	MTS level conflict management style	Moderation effect of MTS conflict management style on spillover from sub team process conflict to MTS level process conflict
6a	Avoid	I expect that higher levels of avoiding conflict management in the MTS will be associated with ***higher*** spillover from sub team to MTS level process conflict.
6b	Accommodate	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level process conflict to MTS level process conflict
6c	Compete	I expect that higher levels of accommodating conflict management in the MTS will ***increase*** the spillover effect from sub team level process conflict to MTS level process conflict
6d	Collaborate	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level process conflict to MTS level process conflict
6e	Compromise	I expect that higher levels of accommodating conflict management in the MTS will ***reduce*** the spillover effect from sub team level process conflict to MTS level process conflict

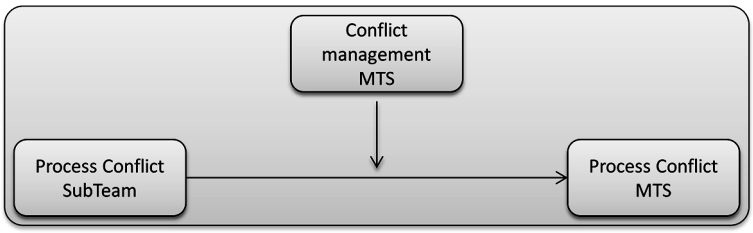

Figure 24 | Moderated Multilevel Process conflict and conflict management

I expect that avoiding conflict (be it process or task conflict) on the sub team level will result in (sub team) conflicts being left unsolved at the sub team level and as a consequence that these conflicts will manifest themselves at the MTS level where they will negatively impact outcome (quality).

Hypothesis 7*: Conflict avoidance on the sub team level is negatively related to quality on the MTS level and this relationship is mediated by task conflict on the MTS level*

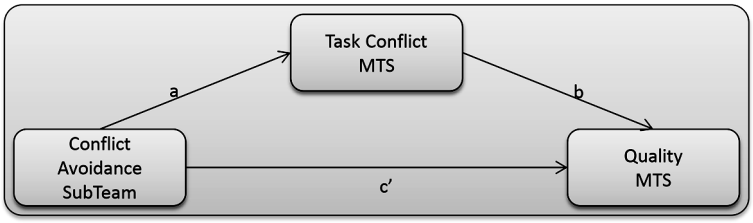

Figure 25 | Mediated Multilevel sub team conflict management and MTS quality (T)

***Hypothesis 8**: Conflict avoidance on the sub team level is negatively related to quality on the MTS level and this relationship is mediated by process conflict on the MTS level*

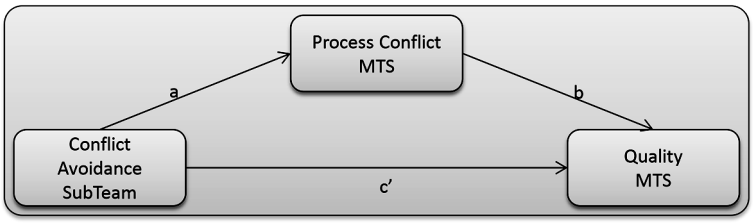

Figure 26 | Mediated Multilevel sub team conflict management and MTS quality (P)

Note that this mediated relationship between conflict management (sub team), conflict (MTS) and outcome (MTS) only applies to the avoiding conflict style. I would expect none of the other conflict management styles (accommodate, compete, collaborate, compromise, cooperate) to give significant results supporting the suggestion that avoiding conflict may lead to the conflict being lifted to the MTS.

6.4 | Method

Data collection and sample that underlie the empirical chapters are described in chapter 3, paragraphs 3.2 and 3.3.

Task Conflict (TC) and Process Conflict (PC)

Over the past decades, multiple scales were developed to measure conflict. For this research, I decided to use the adapted scale that Jehn and Mannix (2001) published and that covers all three types of conflict (relationship, task, process). The scale is a 9-item, 5-point Likert scale with 3 questions per conflict type. The scale was translated to Dutch. Respondents were asked to answer each question both with respect to their own sub team as well as reflecting the entire (MTS) project-team as a whole. In essence, this means that respondents were asked to answer the 9 items of the conflict scale twice – on MTS and on sub team level. Cronbach's alpha for all scales is well above the accepted threshold (.728 for sub team level TC; .763 for MTS level TC; .826 for sub team level PC; .835 for MTS level PC).

Conflict management styles

For conflict management scales, I leveraged the work by Montoya-Weiss et al. (2001). The authors provide a set of scales for five different conflict management behavioral styles labeled avoidance, accommodation, competition, collaboration, and compromise. For each of the styles, a set of 5-point

Likert scale questions is provided. The original scales are individual focused ('I tried to...'). For my purposes, the scales were (a) translated to Dutch; (b) the reference point was shifted to team level ('in my team, we...'). Furthermore, based on scale reliability analysis, I removed some of the scale items. Finally, in a later stage of my analysis I computed $r_{WG(J)}$scores (James, Demaree and Wolf, 1984) to check for sufficient within group agreement. Based on the results, I decided to refrain from using a number of the conflict management variables. The scales I do use in my analyses are *accommodating* conflict management on the MTS level (3 items, Cronbach's alpha=.774), *collaborating* conflict management on the MTS level (4 items, alpha=.816), *avoiding* conflict management (2 items, alpha=.687).

Quality

Quality was measured by a 9 item, 5-point Likert scale (1=strongly disagree; 5=strongly agree). The 9 items focus on different aspects of IS development quality and cover topics such as specifications, issues found during testing, meeting end user requirements. The scale includes 4 reverse coded items. The reliability of the scales as indicated by Cronbach's alpha: .732.

Aggregating to sub team and MTS level

For the conflict and conflict management variables, individual scores were aggregated into sub team level and MTS level scores. For quality, individual scores were aggregated to MTS level. I computed $r_{WG(J)}$scores (James et al., 1984) for each of the applied aggregates to check for sufficient within group agreement (quality on MTS level; task conflict on both MTS and sub team levels; process conflict on both MTS and sub team levels; avoiding conflict on sub team level; accommodating and collaborative conflict management on MTS level). I checked for the recommended cutoff point of .70. Based on this analysis, I removed a number of teams from my dataset and performed the final analysis against a dataset with 35 sub teams and 80 individuals. The remaining dataset shows teams with $r_{WG(J)}$values from .81 upwards for sub team level task conflict; .76 upwards for sub team level process conflict; .77 upward for MTS level task conflict; .73 upwards for MTS level process conflict; .73 upwards for MTS level accommodating conflict management; .78 upwards for MTS level collaborative conflict management; .94 upwards for MTS level quality; and .64 upwards for sub team level avoidance conflict management. Although this latter value is below typically accepted thresholds, I decided to accept the variable and teams involved to maintain a minimum level of teams for the analysis.

Furthermore, I used ANOVA to test between group variance using 'project-id' as factor for the MTS level constructs and 'subTeamIdentifier' for the sub team level constructs. I find the following results: for Task Conflict (sub team level): F(34,48 =1,73 (p=.04); Process Conflict (sub team level): F(34,48)=1,59 (p > .05); Task Conflict (MTS level): F(20,60)=3.07 (p=.00); Process Conflict (MTS level): F(20,60)=3.09 (p=.00); Accommodating conflict (MTS level): F(20,60)=1,16 (p > .05); Collaborating conflict (MTS level): F(20,60)=2.10 (p=.01); Quality (MTS): F(20,62) = 4.05 (p=.00); Avoiding conflict management (sub team level): F(34,48)=1.05.

6.5 | Results

In Table 24 I report the means, standard deviations and correlations between the variables. I see high correlations between the variables suggesting limited differential validity. However, findings in both my own and previous research do suggest that looking at the interactions of these variables may be of interest – hence I will consider them as separate variables in the analysis.

Table 24 | Means, standard deviations and reliabilities for the scales

	Mn	SD	1	2	3	4	5	6	7	8
1. TC sub team	2.27	.56	(.728)							
2. PC sub team	1.91	.64	.546**	(.826)						
3. TC MTS	2.44	.48	.557**	.448**	(.763)					
4. PC MTS	2.12	.52	.371*	.572**	.813**	(.835)				
5. CM avd sub	2.20	.50	.401*	.299	.432**	.457**	(.687)			
6. CM acc MTS	3.11	.35	-.009	-.002	.035	-.176	-.260	(.774)		
7. CM coll MTS	3.69	.36	-.293	-.178	-.592**	-.513**	-.333	.199	(.816)	
8. Quality MTS	3.56	.43	-.385*	-.347*	-.703**	-.618**	-.519**	.010	.611**	(.732)

n=35, * p < .05. ** p < .01 *** p < .001, Cronbach's alpha is presented between brackets

1. TC sub team = Task Conflict on the Sub Team level
2. PC sub team = Process Conflict on the Sub Team level
3. TC MTS = Task Conflict on the MTS level
4. PC MTS = Process Conflict on the Sub Team level
5. CM avd sub = Conflict Management - avoidance style on the Sub Team level
6. CM acc MTS = Conflict Management - accommodate style on the MTS level
7. CM coll MTS = Conflict Management - collaborative style on the MTS level
8. Quality MTS = Quality on the MTS level

This research focuses on Multi-team systems and looks at multilevel effects. This poses specific demands on analysis. As an example: task conflict focused hypothesis H1 only reflects MTS level variables whereas hypotheses H2 and H3 are concerned with variables on both sub team and MTS levels. The same holds for the process conflict related hypotheses (H4 is MTS level only whereas H5 and H6 touch both sub team and MTS levels). Obviously, the multilevel regression requires a dataset containing both MTS and sub team level data. On the other hand, if I were to use that same dataset to test H1 and H4, the results would be inflated as a consequence of each MTS consisting of two sub teams. I therefore tested H1 and H4 against a separate, MTS level data only, dataset.

In order to test H1, I regressed TC on the MTS level on Quality (MTS level). This step included an OLS regression. The association between Task Conflict and Quality (both on Multi-team system level) is negative and significant (β= -.690, p=.001) supporting hypothesis 1. Detailed results are presented in Table 25.

Table 25 | Results for Hypothesis 1

		Dependent var. Quality (MTS level)
	Independent var.	
H1	Task Conflict on MTS level	-.690***
	F-Change	17.280***
	R^2	.476
	Adj. R^2	.449

As the table shows, hypothesis 1 is supported.
Hypothesis 2 involves the mediation effect that Task Conflict on the MTS level is expected to have on the relationship between sub team level Task Conflict and MTS level quality. In order to determine mediation effects, various methods exist. One of the most commonly used is the Baron and Kenny (1986) method. This method – the causal steps approach – estimates the various paths in the model and performs a number of statistical checks.

Applying the causal steps approach to hypothesis 2 shows that: β11 = -.296 is significant (p=.022); β21 = .481 is significant (p=.001); β31 = -.624 is significant (p=.000); β42 = -.628 is significant (p=.000). The results also show that abs(β41) < abs(β11) (.007 < .296) and that β41 is no longer significant. Based on this reasoning, hypothesis 2 is supported: MTS level TC mediates the relationship between TC on the sub team level and quality on the MTS level.

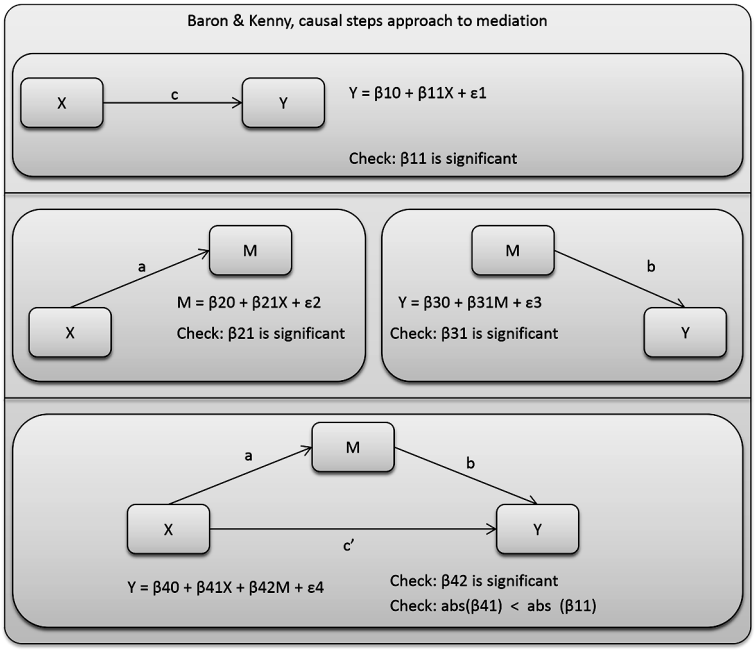

Figure 27 | Baron & Kenny causal steps approach

The causal steps mechanism to check for mediation received various criticisms. Shrout and Bolger (2002) state that developments in statistical theory provide alternative methods for testing direct and indirect effects in mediation models. One particularly useful approach is the bootstrap framework, which can be applied even when sample sizes are moderate or small (Efron & Tibshirani, 1993). In addition, Hayes (2009) suggests that the causal steps approach has been criticized heavily because 'it is low in power' and because 'it is not based on a quantification of the very thing it is attempting to test: the intervening effect'. Bootstrapping is a method that seems to be gaining ground in determining mediation. Hayes (2012) supplies add-on software for SPSS that offers bootstrapping capabilities. I replicated the mediation analysis using Hayes' (2012). Detailed results for Hypothesis 2 can be found in Table 29.

These results show that with bootstrapping, using sub team level Task Conflict as the predictor, MTS level task conflict as mediator, and Quality at the MTS level as the dependent variable, the direct effect of sub team level TC on MTS level quality is marginally positive yet not significant (β= .007, p=.95) whereas the indirect effect of sub team level TC on MTS quality mediated by MTS TC is negative and significant (β= -.30, 95% CI [-.50;-.14]).

The findings show support for hypothesis 2.

Hypothesis 3 discusses an expected moderation effect between MTS level conflict management styles on the multilevel spillover effect from sub team level Task Conflict to MTS level Task Conflict. As discussed, based on scale reliability and $r_{WG(J)}$scores, I limit myself to (a) accommodating conflict management and (b) collaborating conflict management.

Hayes (2012) bootstrapping module offers an elegant method for testing moderation. The moderation effect of accommodating conflict behavior is not supported – the interaction effect is insignificant (p=.3005). The 'normal' approach on calculating moderation – using a 2-step linear regression that includes the interaction effect in step 2 – provides an identical insignificant (p=.300) interaction effect. For collaborative conflict behavior, the interaction effect again is insignificant (p=3.788). A stepwise OLS regression provides the same (p=.379) result.
Hypothesis 3 is not supported.

In order to test hypothesis 4, I regressed PC on the MTS level on Quality (MTS level). This step included an OLS regression. The association between Process Conflict and Quality (both on the Multi-team system level) is negative and significant (β= -.604, p=.004) supporting hypothesis 4. Results are presented in Table 26.

Table 26 | Results for Hypothesis 4

	Independent var.	Dependent var. Quality (MTS level)
H4	Process Conflict on MTS level	-.604**
	F-Change	10.898***
	R^2	.365
	Adj. R^2	.331

Hypothesis 5 involves the mediation effect that Process Conflict on the MTS level is expected to have on the relationship between sub team level Process Conflict and MTS level quality. As with the similar hypothesis 2, I used both the traditional causal steps approach and Hayes (2012) to test for the suggested mediation.

The bootstrapping software made available by Hayes (Hayes, 2012) shows that the indirect (mediated by MTS level Process Conflict) association between sub team level PC and MTS Quality is negative and significant (β= -.24, 95% CI [-.43;-.09]) whereas the direct effect of sub team level PC on MTS quality is non significant (β= .006, p=.96). These findings support hypothesis 5. Detailed results for Hypothesis 5 can be found in Table 30.

In hypothesis 6, I discuss the expected moderation effect between MTS level conflict management styles on the multilevel spillover effect from sub team level Process Conflict to MTS level Process Conflict. Again I limit myself to (a) accommodating conflict management and (b) collaborating conflict management, and I use Hayes (2012) bootstrapping module to test this hypothesis. The results are significant both for conflict management styles.

For the accommodating conflict management style: the association between sub team level PC and MTS level PC is positive and significant (p=.033). For low levels of MTS level accommodating conflict behavior (β=.8245, p=.0002), for medium MTS level accommodating conflict behavior, the association is also positive and significant but is smaller (β=.5983, p=.0000) and finally, at high levels of MTS level accommodating conflict behavior, the association between sub team level PC and MTS level PC becomes even smaller but is still significant (β=.3721, p=.0032). In summary: the Process Conflict spillover effect declines if MTS level accommodating conflict management behavior is stronger, supporting this part of the hypothesis.

For the collaborative conflict management style: similar significant (p=.024) results. Process Conflict spillover from sub team to MTS is smaller for higher levels of collaborative conflict management in the MTS: (for low collaborative conflict management: β=.6631, p=.0001; medium: β=.4261, p=.0001; high: β=.1892, p=.1621 - insignificant) partly supporting this part of the hypothesis.
Details can be found in Table 27.

Table 27 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 6

MTS level conflict management style	Moderation effect of MTS conflict management style on spillover from Sub team Process conflict to MTS level process conflict					Result
Accommodate	Significant, p=.033 Conditional effect of X on Y at values of the moderator(s)					Supported
	CflcMg	**Effect**	**se**	**t**	**p**	
	2,7658	,8245	,1950	4,2295	,0002	
	3,1117	,5983	,1242	4,8158	,0000	
	3,4577	,3721	,1164	3,1971	,0032	
	The spillover from sub team level Process conflict to MTS level process conflict is smaller with higher accommodating conflict management at the MTS level					
Collaborate	Significant, p=.024 Conditional effect of X on Y at values of the moderator(s)					Supported
	CflcMg	**Effect**	**se**	**t**	**p**	
	3,3283	,6631	,1459	4,5449	,0001	
	3,6936	,4261	,0969	4,3967	,0001	
	4,0588	,1892	,1321	1,4322	,1621	
	The spillover from sub team level Process conflict to MTS level process conflict is smaller with higher collaborating conflict management at the MTS level					

X=Process Conflict on Sub Team level;

Y=Process Conflict on MTS level

M=Conflict management on MTS level (different types of conflict management)

A stepwise OLS regression provides the same significance (p=.033) for the overall indirect effect. I conclude that hypothesis 6 is partially supported.

Finally, in hypotheses 7 and 8, I suggest an effect between sub team level conflict avoidance and MTS level quality, mediated by MTS level conflict. Using Hayes' bootstrapping approach I find that the indirect (mediated by MTS level Task Conflict) association between sub team level conflict avoidance behavior and MTS Quality is negative and significant (β= -.2169, 95% CI [-.3670;-.1024]). Detailed results for hypothesis 7 can be found in Table 31.
The findings show support for hypothesis 7.

For hypothesis 8 I follow the same steps and the findings show that that the indirect (mediated by MTS level Process Conflict) association between sub team level conflict avoidance behavior and MTS Quality is negative and significant (β= -.1875, 95% CI [-.3327;-.0851]). Detailed results for hypothesis 8 can be found Table 32.
The findings show support for hypothesis 8.

6.6 | Discussion and managerial implications

The negative relationships that I find between task conflict/team performance and process conflict/team performance are supported by findings from many other researchers. I also discussed that literature exists that finds *positive* relationships between task conflict and team performance and between process conflict and team performance including Behfar et al. 2011), Greer et al. (2008), Peterson and Behfar (2003), Jehn and Mannix (2001), Ensley and Pearce (2001), Jehn and Chatman (2000), Simons and Peterson (2000), Pelled (1996), Jehn (1995). The typical explanations the authors provide include: task conflict brings in different opinions and viewpoints increasing overall knowledge and understanding, higher levels of involvement and hence better acceptance of decisions, increased confidence, stimulate engagement.

Similarly, process conflict also was found to have positive effects on performance by for instance deWit et al. (2012), Behfar et al. (2011), Goncalo et al. (2010), Jehn and Mannix (2001), and Jehn (1997). Explanations suggest that process conflict may lead to explicit agreements about how the group will work together, may help clarify issues such as roles and responsibilities, may facilitate crucial reevaluations of processes, standards, and task and resource assignments.

In the context of OISDP MTSs, these seemingly inconsistent findings can be explained by temporal effects. Since the underlying business case for IS development outsourcing typically is based on the following drivers: efficiency (cost reduction), access to knowledge based resources such as specialized ICT knowledge, and focusing on core business. This suggests that, in order to actually reap these expected benefits, the client and vendor sub teams must be allowed to focus on their own, specialized, tasks during a significant part of the project. During this project phase, the previously accumulated shared knowledge must be sufficient to allow both sub teams to function relatively independently. This suggests that, given the knowledge intensive and non routine work that these MTSs are confronted with, shared knowledge is a necessity (both task and team/process shared knowledge). I would therefore expect to see that in early stages of IS development MTSs, task and process conflict are *inevitable* as they support the build-up of sufficient shared knowledge in the sub teams and the MTS. In fact, I would actually expect task and process conflict to *benefit* performance during this stage of the project's lifecycle since the build-up of sufficient shared (task and team) knowledge is a pre requisite for success. Further longitudinal research would be required to measure the effects of task and process conflict on team performance per performance episode or stage in the project's lifecycle. In summary, I posit that high levels of task conflict are symptomatic of insufficient levels of shared task knowledge and, similarly, high levels of process conflict are symptomatic of insufficient shared process/team knowledge.

Similar reasoning can be applied to the combination of Process Conflict and SKIF. By combining these perspectives, managers responsible can become *consciously competent*, pro-actively manage the various team stages and effectively *use* both task and process conflict.

In addition, I looked at different conflict management styles. Although the quantity of data I had available did not allow me to investigate all conflict management styles, I did find significant mediation results (for process conflict spillover) for accommodating and collaborative conflict management on the MTS level. These results suggest that cooperative conflict management styles on the MTS level can alleviate process conflict spillover effects. These findings are consistent with Kellermanns et al. (2008) results on constructive confrontation.
They suggest that when strong norms of constructive confrontation are in place, teams are in a better position to reap the benefits of conflict (greater diversity of inputs) without experiencing its negative consequences (Kellermanns et al., 2008). In addition, shared understanding and coordination only happens when team members share ideas about task processes and outcomes (Kellermanns et al., 2008; Cannon-Bowers & Salas, 2001).

Finally, I looked at the effects that conflict avoidance in the sub team may have on team performance on the MTS level and found that, as expected, avoiding conflict on the sub team level is negatively related to MTS performance, mediated by MTS level conflict. The managerial lesson to be learned is that sub team managers should actively work on solving conflicts in their own sub teams; ignoring or avoiding sub team level conflict is predictive for higher conflict levels on the MTS level.

From a managerial perspective, the findings show that if sub team and MTS managers are aware of the multi team dynamics, conflict types and conflict management styles, they can consciously manage conflict to prevent detrimental effects. The multi team system model implies that in a 'team of teams' different dynamics may play on different levels (sub team, MTS); the findings show that indeed conflict spillover takes place and that mediation and moderation effects exist in this multi level context. For sub team level managers, it is important that they realize that their actions (or lack thereof) may not only impact their own sub team, but may also impact the entire MTS and overall quality. For example, the findings show that conflict avoidance on the sub team level is negatively associated with overall MTS quality through task and process conflict on the MTS level.

Similarly, on the MTS level, managers should be aware that Task as well as Process conflict show negative associations with overall quality. Whereas these types of conflict may be partly a necessity to build sufficient SKIS and SKIF, care must be taken to not allow them to distract from the overall objective. In addition, managers on the MTS level should be aware that they may 'inherit' (spillover) conflict from their sub teams and that appropriate uses of conflict management styles on the MTS level can help manage the potentially negative effects of such spilled over sub team conflict – for instance the accommodating and collaborative management styles on the MTS level were found to moderate the relationship between sub team level process conflict and overall quality.

In short, being aware of multi team dynamics and conflict spillover effects and the awareness that various conflict management styles exists, allows for appropriate interventions on both sub team and MTS level alleviating the potentially negative effects of task and process conflict.

Limitations and suggestions for future research

I decided to do this research in a real world environment with real projects and in a specific – but common – context: that of client/vendor MTS development teams. The research is based on a relatively small number of teams – studies that cover more teams are recommended. I touched upon the relationship between shared knowledge and conflict in sub teams and MTSs as my research is based on an underlying framework that suggests that outsourced IS development projects require specialization but that, in order to successfully specialize, companies need to do the opposite first: invest in shared knowledge and team cognition. I suggest that task and process conflict are inevitable as means to build the required levels of shared knowledge. As a consequence, I expect that in different phases of the IS development project, conflict plays different roles. Investigating these temporal effects requires longitudinal research.

Another interesting angle for future research may be derived from a suggested link between my model, the findings and the well-known Maslow model on learning phases (phases labeled *unconscious incompetence, conscious incompetence, conscious competence, and unconscious competence*). This linkage, depicted in the table below, also lists expected effects of each combination on team performance and team satisfaction. Further investigation of the following table might lead to interesting insights in team dynamics:

Table 28 | Mapping Maslow's learning phases with team cognition

Level of task Conflict (l-low, h-high)	Level of SKIS (l-low, h-high)	Maslow's stage	Expected team performance	Expected individual satisfaction with team
L	L	Unconscious Incompetence	Low	High (*innocent bliss*)
H	L	Conscious Incompetence	Still low	Low (*perceived conflict, frustration*)
H	H	Conscious Competence	Increasing	Diverse, ups & downs
L	H	Unconscious Competence	High	High (*part of an effective team*)

Thirdly, my research is based on large, traditional IS development projects that use the so called waterfall development approach – still typical to most large outsourced IS development projects. I do see growing attention for Agile development methods. Such methods are inherently more focused on close client/vendor cooperation and therefore can be expected to show different dynamics when it comes to both information sharing and conflict. Researching conflict dynamics in large Agile development environments may provide additional insights.

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6.8 | Tables & Figures

Table 29 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 2

Run MATRIX procedure:
*************** PROCESS Procedure for SPSS Beta Release 130612 ***************
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

```
**************************************************************************
Model = 4
Y = e_Qualit
X = s_TaskCf
M = e_TaskCf

Sample size
35

**************************************************************************
Outcome: e_TaskCf

Model Summary
R           R-sq        F          df1        df2          p
,5567       ,3099       14,8165    1,0000     33,0000      ,0005

Model
            coeff       se         t          p
constant    1,3483      ,2924      4,6115     ,0001
s_TaskCf    ,4812       ,1250      3,8492     ,0005

**************************************************************************
Outcome: e_Qualit

Model Summary
     R          R-sq       F          df1        df2          p
   ,7035        ,4949      15,6761    2,0000     32,0000      ,0000

Model
            coeff       se         t          p
constant    5,0814      ,2889      17,5896    ,0000
e_TaskCf    -,6282      ,1341      -4,6840    ,0000
s_TaskCf    ,0068       ,1159      ,0586      ,9536
```

```
****************** DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE          t           p
   ,0068       ,1159       ,0586       ,9536

Indirect effect of X on Y
Effect          Boot          SE        BootLLCI     BootULCI
e_TaskCf      -,3023       ,0894       -,4958       -,1440

****************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_TaskCf = Task Conflict (sub team level)
- M = e_TaskCf = Task Conflict (MTS level)

- The coefficients (-.6282, .0068) match the coefficients that I found using the Baron & Kenny causal steps approach.
- The direct effect (p=.9536) is non-significant.
- The bootstrap interval, depicted by its lower- and upper limits (-.4958 and -.1440 respectively) does not contain 0 hence show a significant indirect effect of X (TC Sub Team) on Y (Quality MTS) through the mediator (TC MTS level).

Table 30 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 5

Run MATRIX procedure:
**************** PROCESS Procedure for SPSS Beta Release 130612 ****************
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

```
**************************************************************************
Model = 4
Y = e_Qualit
X = s_ProcCf
M = e_ProcCf

Sample size
35

**************************************************************************
Outcome: e_ProcCf

Model Summary
      R         R-sq          F          df1          df2          p
  ,5716       ,3267     16,0138       1,0000      33,0000      ,0003

Model
              coeff         se          t          p
constant     1,2298      ,2336     5,2643     ,0000
s_ProcCf      ,4648      ,1161     4,0017     ,0003

**************************************************************************
Outcome: e_Qualit

Model Summary
R           R-sq        F          df1          df2          p
,6180       ,3819     9,8847       2,0000      32,0000      ,0005

Model
              coeff         se          t          p
constant     4,6325      ,2528    18,3269     ,0000
e_ProcCf     -,5108      ,1389    -3,6784     ,0009
s_ProcCf      ,0060      ,1129      ,0530     ,9581
```

```
********************* DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE               t               p
   ,0060        ,1129          ,0530          ,9581

Indirect effect of X on Y
   Effect         Boot             SE          BootLLCI      BootULCI
 e_ProcCf      -,2374          ,0855          -,4266          -,0911

********************* ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_ProcCf = Process Conflict (sub team level)
- M = e_ProcCf = Process Conflict (MTS level)

Relationship between sub team level Process Conflict and MTS level Process Conflict moderated by conflict management on the MTS level. A summary of the findings:

Table 31 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 7

Run MATRIX procedure:

********** **PROCESS Procedure for SPSS Beta Release 130612** **********

Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

```
**************************************************************************
Model = 4
Y = e_Qualit
X = s_CflcMg
M = e_TaskCf

Sample size
35

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Beta Release 130612 **********

 Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

**************************************************************************
Model = 4
Y = e_Qualit
X = s_CflcMg
M = e_TaskCf

Sample size
35

**************************************************************************
Outcome: e_TaskCf

Model Summary
R         R-sq         F          df1          df2          p
,4322     ,1868        7,5786     1,0000       33,0000      ,0095

Model
                coeff         se          t           p
constant      1,5270      ,3407      4,4817      ,0001
s_CflcMg       ,4152      ,1508      2,7529      ,0095
```

```
**************************************************************************
Outcome: e_Qualit

Model Summary
      R         R-sq          F          df1          df2          p
   ,7429       ,5519      19,7028      2,0000      32,0000      ,0000

Model
                 coeff          se          t          p
constant       5,3355       ,2889     18,4679      ,0000
e_TaskCf       -,5224       ,1164     -4,4884      ,0001
s_CflcMg       -,2256       ,1118     -2,0179      ,0521

****************** DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE          t          p
   -,2256       ,1118     -2,0179      ,0521

Indirect effect of X on Y
Effect          Boot          SE        BootLLCI      BootULCI
e_TaskCf       -,2169       ,0673        -,3670        -,1024

******************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_CflcMg = Avoidance conflict management (sub team level)
- M = e_TaskCf = Task Conflict (MTS level)

Table 32 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 8

Run MATRIX procedure:
********** **PROCESS Procedure for SPSS Beta Release 130612** **********
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

Model = 4
Y = e_Qualit
X = s_CflcMg
M = e_ProcCf

Sample size
35

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Beta Release 130612 **********

Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

****
Model = 4
Y = e_Qualit
X = s_CflcMg
M = e_ProcCf

Sample size
35

****
Outcome: e_ProcCf

Model Summary

R	R-sq	F	df1	df2	p
,4574	,2092	8,7301	1,0000	33,0000	,0057

Model

	coeff	se	t	p
constant	1,0693	,3634	2,9420	,0059
s_CflcMg	,4754	,1609	2,9547	,0057

```
**************************************************************************
Outcome: e_Qualit

Model Summary
      R        R-sq         F          df1         df2          p
   ,6728       ,4527     13,2334     2,0000     32,0000      ,0001

Model
                coeff         se          t          p
constant      4,9595      ,2828     17,5357      ,0000
e_ProcCf      -,3943      ,1206     -3,2706      ,0026
s_CflcMg      -,2551      ,1253     -2,0354      ,0502

******************** DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE          t          p
   -,2551      ,1253     -2,0354      ,0502

Indirect effect of X on Y
Effect         Boot         SE         BootLLCI     BootULCI
   e_ProcCf  -,1875      ,0613      -,3327       -,0851

******************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_CflcMg = Avoidance conflict management (sub team level)
- M = e_ProcCf = Process Conflict (MTS level)

CHAPTER 7

Team Cognition and Outcome in Cross Organizational Multi Team Information System Development Teams

Abstract

Information Systems development requires specialized expertise and is typically a (project) team effort. *Outsourced* IS development results in the use of Multi-team systems (MTS): sub teams of client and vendor who together form an MTS responsible for building the required Information System. Such MTSs must share information and knowledge to be successful. On the other hand, they must focus on their own, specialized, tasks. This dilemma of sharing and overlap versus specialization and uniqueness, raises questions on the effects that different types of shared knowledge have on team performance and on multilevel aspects (sub team and MTS) of knowledge sharing. Research with real IS development projects shows that shared task and shared team knowledge do impact overall team performance and that multilevel aspects play an important role. In this chapter I examine the effects of shared knowledge on outcome in the context of client and vendor IS development teams (cross organizational Multi-team systems). My findings show that two types of shared knowledge (content/task related and team/process related) both impact overall team performance. The main practical implications are that investing in shared task and shared team mental models on both sub team and MTS level, positively impacts team performance.

Keywords: Information System development, shared mental model, multi-team system (MTS)

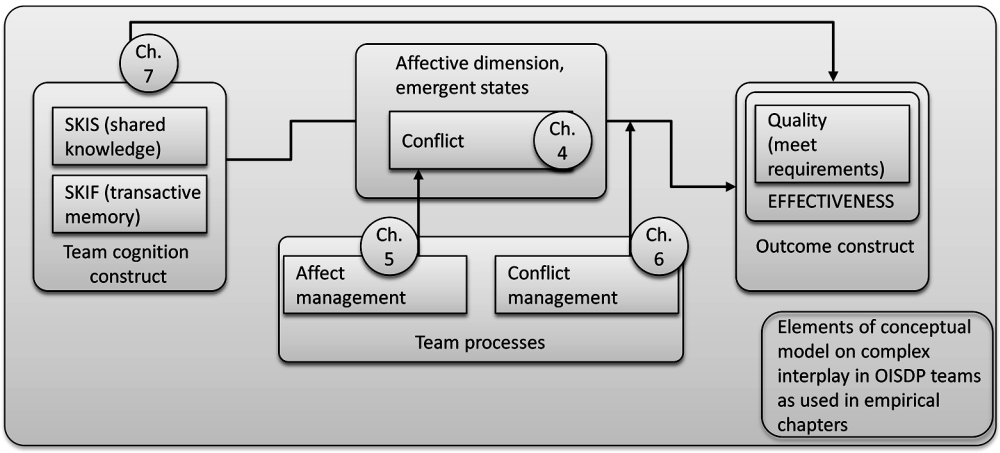

Figure 28 | Positioning chapter 7

7.1 | Introduction

IS development requires knowledge and expertise from different domains since the work typically involves complex, dynamic, and unstructured tasks (He et al., 2007). Increasingly, organizations use external vendors to build their Information Systems (IS development outsourcing).

Many outsourced large software development projects cannot deliver a satisfactory cost effective product on time and anticipated financial benefits are often not achieved (Aron & Singh, 2005; Levina & Ross, 2003). It is, therefore, critical to better understand how these *outsourced information system development projects* (**OISDP**) can succeed and to develop ways in which they can be more efficiently and effectively managed.

OISDPs involve cross organizational, client/vendor multi-team systems (MTSs) to produce the required end result. These MTSs consist of two sub teams, one that is composed of the client's staff and one from the vendor's. Multi-team systems are networks of teams that pursue different proximal goals, and at the same time share one or several distal ones (Marks et al., 2001). IS development work is knowledge intensive and information exchange and sharing within teams in system development is crucial to be successful (Hsu et al., 2011). Furthermore, the division of labor among teams and members is highly interdependent (Ryan & O' Connor, 2013). In the case of MTSs, the effectiveness of the MTS depends on *within* as well as *between* team coordination and communication processes (Marks et al., 2005). Research into multi-team systems showed that failure of such MTSs often results from misalignment between the sub teams; the subsystems were pulling against each other (DeChurch & Zaccaro, 2010).

Besides explicit coordination mechanisms such as planning, many team processes are thought to rely on team knowledge. Team knowledge is multifaceted and comprised of relatively generic knowledge in the form of team mental models and more specific team situation models. Research shows that team effectiveness will improve if team members have an adequate shared understanding of the task, team, equipment, and situation (Mohammed, 2001). In this chapter, I follow the calls of other researchers to *learn about how different team cognition constructs relate to one another in influencing team effectiveness* (Wildman et al., 2012), to *further examine the interrelations between different aspects of team knowledge* (Mesmer-Magnus & deChurch, 2009), and to provide *a study that defines shared knowledge in several ways* (Cannon-Bowers & Salas, 2001).

Team literature suggests that a shared task understanding emerges over time as a result of interaction and team learning processes and is beneficial for performance (Cooke et al., 2003). In this chapter I focus on shared task understanding and specialization and their interplay as influenced by: (1) the bi-dimensional evolution of OISDPs, and (2) the multilevel dynamics of the MTS. I also use insights from literature on team cognition and team dynamics for advancing a set of propositions concerning the interplay between team processes, emergent states (teamwork quality), and information sharing in OISDPs.

This chapter has both theoretical and practical implications. It adds to the team cognition literature by distinguishing between knowledge sharing and accuracy. First I concur that the impact of sharing on performance is beneficial (Mohammed et al., 2010), but is contingent on the accuracy of the shared knowledge. Second, I provide practical insights for managing OISDPs by showing that shared knowledge on task and team are important for OISDP effectiveness.

7.2 | Theoretical Background

In paragraph 2.2, I introduced the constructs used in literature to reflect IS development teams performance. Please refer to paragraph 2.2 for details. In short: team performance is defined as a multi-dimensional construct focusing on: quality (technical properties), adherence to budget (costs), and adherence to schedule (time) (Hoegl et al., 2004).

Team cognition was introduced extensively in paragraphs 2.3.6 and 2.4 and was discussed further in paragraph 6.2. In short, without team cognition, efficient sharing of knowledge, coordination, and conflict resolution will not be possible (He et al., 2007; Cannon-Bowers & Salas, 2001; Hollingshead, 2001) in IS development teams. Various theoretical reviews and empirical studies connect team cognition, taskwork and teamwork mental models to team outcomes and team effectiveness (Mohammed et al., 2010; Rafaeli et al., 2009; Lim & Klein, 2006; Mathieu et al., 2005; Rentsch & Klimoski, 2001; Mathieu et al., 2000). Findings show that these effects are particularly strong in the context of complex tasks where team coordination is critical (Rafaeli et al., 2009).

As discussed in paragraph 2.3.2, effectiveness requires that both sub teams work toward the same task, requiring shared knowledge on the system to be built. Coordinated cognitive activity depends upon a shared understanding of what is being discussed (Levine et al. ,1993) and a team needs to have a common or shared frame of reference to properly interpret information (Ellis et al., 2003). Achieving shared understanding among geographically dispersed workers is a central concern (Vlaar et al., 2008). Mohammed et al. (2010) showed that high quality teamwork and emergent shared knowledge structures are crucial for successful collective performance across different group development stages. Team cognition plays an important role in that it '*allow(s) team members to draw on their own well-structured knowledge as a basis for selecting actions that are consistent and coordinated with those of their teammates*' (Mathieu et al., 2000; He et al., 2007).

Efficiency in outsourced IS development requires that the work is done with as little cost and overhead as possible implying specialized tasks and efficient interfaces (team members must know where to go for answers or additional expertise). Collective tasks require complementary knowledge possessed by different team members as posited by transactive memory theory (Ryan & O' Connor, 2013).

As was discussed in paragraph 2.3.6, team cognition has been studied under different names such as shared cognition, team mental models, transactive memory, shared mental models, and team knowledge. I conceptualize team cognition as the emergent knowledge structures (e.g., shared mental models) that develop as a result of team interactions (Wildman et al., 2012; Klimoski & Mohammed, 1994), allowing us to see team cognition both as an input and as an output of team processes.

In paragraph 2.3.6 I discussed the two cognitive structures that dominate literature (transactive memory, emphasizing distinctive cognitive elements, and team or shared mental models emphasizing common cognitive elements). These two constructs reflect the two opposite meanings of sharing: shared-as-in-common versus shared-as-distributed. I suggest that in OISDPs, both types of sharing are a necessity and the balance between the two is a success factor in these multi-team systems.

Shared Mental Models

The concept of shared or team mental models was discussed in paragraph 2.3.6. In short: SMMs reflect '*team members' shared, organized understanding and mental representation of knowledge or beliefs about key elements of the team's relevant environment*' (Wildman et al., 2012; Mohammed et al., 2000, p. 125). Their relevance in team performance can be explained by the use of a common language, enabling better coordination of action, facilitation of information processing (Lim & Klein, 2006; Banks & Millward, 2000; Kraiger & Wenzel, 1997), and enhancing coordination (Baker & Salas, 1997). Typically, task mental models (a common schema regarding the tasks at hand) and team mental models (regarding interaction between team members) are distinguished.

Transactive Memory System

Transactive memory systems as well were discussed in paragraph 2.3.6. In short: Transactive memory is defined as a set of knowledge possessed by the members of a team, combined with an awareness of who knows what (Rau, 2005; Faraj & Sproull, 2000) and can be considered a multidimensional construct (knowledge stock, consensus, knowledge specialization, and accuracy), Austin (2003). There is ample evidence that transactive memory positively influences group performance.

In paragraph 2.5.1, (Team cognition: a dynamic, multilevel model of team cognition in OISDPs), I introduced the dynamic model including OISDP performance, SKIS and SKIF (reflecting respectively shared mental models and transactive memory systems).

'SKIS' – Shared Mental Models in OISDPs.

I suggest that in an OISDP MTS, task related knowledge refers to the information system to be developed. I refer to this type of shared knowledge as SKIS – Shared Knowledge on the Information System. SKIS is task related, encompasses Wildman's task and goal related knowledge and is based on the shared mental model construct.

Like Ryan and O' Connor (2013), who specify a multitude of reasons – such as sharing domain expertise and identifying requirements – that underline the need for knowledge sharing in software development teams, I discussed multiple findings in paragraph 2.5.1 that support the assumption that SKIS is of critical importance for OISDP performance. The findings discussed in paragraph 2.5.1 include Xiang et al. (2013) who found that one of the reasons behind IS development project failures is the lack of knowledge sharing in teams; Han and Hovav (2013) who show that knowledge sharing among project team members is crucial for project performance; Tesch et al. (2009) who states that IS developers and users must work together to integrate their technical and application domain knowledge; He et al. (2007) who suggest that shared task understanding is critical in IS development teams and that people in software projects need a common view of relevant issues.

In the outsourced IS development context of OISDPs, these issues will be exacerbated due to different organizational backgrounds of the sub teams.

Because it is not possible to cover every requirement unambiguously in the specifications prior to project execution, divergence and convergence in interpreting information is unavoidable. Accurate interpretation requires a level of common knowledge and understanding about the system that is to be built. SKIS (or in general 'task mental models') is critical for exchanging ideas and fostering solutions among team members when there is a need to exchange unique knowledge and expertise (Hsu et al., 2011). Similar to Xiang et al. (2013), I consider Shared Mental Models to be of relevance to multi-team systems in IS development because such SMMs are required to support the cross-functional integration of task and goals.

In short: in order to successfully (effectiveness) build an information system, the actors and sub teams involved in the OISDP MTS need to coordinate and communicate as well as interpret information. Therefore a certain level of SKIS is necessary.

'SKIF' – Transactive Memory in OISDPs

Team related knowledge refers to knowledge regarding who knows what and knowledge regarding the client/vendor inter-organizational interface. I refer to this type as SKIF – Shared Knowledge on the InterFace. SKIF focuses on Wildman's team and process related elements and is based on the transactive memory construct.

The second performance aspect that Multi-team systems responsible for OISDPs will be measured by is efficiency (budget, time). The typical business case for outsourcing is related to cost savings. This poses OISDPs with an interesting dilemma: sufficient task related shared knowledge (SKIS) is a necessity to be able to build the correct information system (effectiveness objective) whereas efficiency requires that the work is done with as little cost and overhead as possible – everyone does his/her own specialized task – requiring SKIF.

The division of labor between client and vendor sub teams in OISDPs implies the need for a coordinated interface and for effective inter (sub) team coordination. This is where SKIF plays an important role. SKIF can be expected to improve coordination while reducing communication costs. In addition SKIF allows for specialization, which can reduce the repetition of effort, enabling better access to a wide range of expertise (Austin, 2003; Hollingshead, 2001), and which is critical to support the underlying OISDP drivers of cost and specialization.

The necessary level of knowledge redundancy, or common knowledge, between users and IS developers has not been explicitly examined (Tesch et. al., 2009). I hypothesize that for outsourced IS development a thin interface is a necessity in order to reap the financial cost benefits given the cost involved in maintaining a thick client/vendor interface. However: I argue that a thick interface will be required at the start of these projects in order to build sufficient shared knowledge since specialization requires a certain level of common knowledge to make sure that parties understand each other properly (Herbsleb et al., 2005).
Without sufficient knowledge transfer, a successful system cannot be developed. But, since it is more costly to maintain strong ties than weak ones (Hansen, 1999), it follows that both client and vendor will want to move to a thinner interface (weak ties).

I discussed ample evidence in paragraph 2.5.1 showing the importance of transactive memory systems including: Han and Hovav (2013) who discuss the importance of team members knowing where to find support and information; Hsu et al. (2012) who state that transactive memory systems allow for alignment of actions among different people, enabling the team to function in a smoother manner, and for collective tasks or problem solving using complementary knowledge possessed by different team members; He et al. (2007) who explain that awareness of expertise location is important in software development teams by playing an integrative and coordinative function; Hansen (1999) discussing the importance of bridging to allow for access to diverse required resources.

I hypothesize that SKIF is the mechanism that supports effective and efficient coordination in the context of outsourced IS development. SKIF (or teamwork mental models in general) can facilitate team processes to be more efficient and effective (Hsu et al., 2011; Mathieu et al., 2005). In addition, team members with a better understanding of how to interact should be able to effectively exchange and utilize the information collectively held by the group (Hsu et al., 2011).

I suggest that in the context IS development, teams will need both forms (in common and distributed) of sharedness and that openness and shared task understanding necessarily must precede uniqueness and specialization for the multi-team system to be successful.

7.3 | Hypotheses

My model suggests that well performing client/vendor IS development multi-team systems require sufficient levels of SKIS and SKIF. The importance of both SKIS and SKIF were discussed extensively in previous paragraphs (see paragraphs 2.3.6, 2.4, 2.5, and 7.2). From these discussions, it is immediately obvious that (task related) Shared Knowledge on the Information System is a prerequisite for success (without knowing what must be built, the team cannot build it).

I therefore expect a positive correlation between SKIS and Quality on the MTS level.

> ***Hypothesis 1****: Shared Knowledge on the Information System (SKIS) on the MTS level is positively associated with Quality on the MTS level.*

Similarly, I posit that Shared Knowledge on the Interface (SKIF) is important for quality. Among other (efficiency related) benefits, SKIF allows for sufficient (distributed) knowledge stock (Austin, 2003) and in doing so, "enhances the team's ability to bring a greater amount of knowledge at group level to bear on IS-development tasks when needed." (Hsu et al., 2012) and "team members with a better understanding of how to interact should be able to effectively exchange and utilize the information collectively held by the group" (Hsu et al., 2011).

In addition, OISD projects are without exception time-pressured projects suggesting that inefficiency and time loss lead to quality issues since there simply is not enough time to do things right. A common example in IS-development projects is that the time available to thoroughly test the system that was built suffers from delays and time overruns during the preparation and development phases. Therefore, it can be expected that efficiency increasing mechanisms also positively impact quality. Since SKIF is a mechanism that supports effective and efficient coordination in the context of outsourced IS development, it can be expected to be positively related not just to efficiency but also to quality. SKIF represents transactive memory, which *can facilitate team processes to be more efficient and effective* (Hsu et al., 2011; Mathieu et al., 2005). I therefore expect a positive correlation between SKIF and Quality on the MTS level.

> ***Hypothesis 2****: Shared Knowledge on the InterFace (SKIF) on the MTS level is positively associated with Quality on the MTS level.*

From this reasoning, it follows that it is relevant to investigate what factors on the sub team level will influence the above mentioned multi-team system SKIS and SKIF and, in doing so, leverage existing theory to gain additional theoretical knowledge on the effectiveness of MTSs and IS development teams and, after substantiating the theoretical insights by empirical research, derive practical managerial implications. In OISDPs the sub teams belong to different organizations. The sub teams will be separately managed by their own project managers. This immediately suggests that shared knowledge – be it SKIF or SKIS – can emerge and exist on various levels in an OISDP MTS.

Cannon-Bowers and Salas (2001) stated the question what shared exactly means and suggested that researchers must be very clear on their interpretation. In my case, shared knowledge can exist on the sub team level (client and vendor sub team) and on the MTS level.

Although shared knowledge is important, simply being shared may not be enough. The accuracy of the shared knowledge is of importance as well. That is: it is imaginable that both sub teams develop a highly shared (sub team level) team mental model but that the two sub teams develop *different* shared (sub team level) models. One (or both) of the two emerging sub team models may be inaccurate. Lim and Klein (2006) claim that both accurate as well as inaccurate models may be shared. Both the client and vendor sub teams are, by definition, part of the MTS. It can therefore be expected that sub team level shared knowledge and MTS quality are correlated. However, given the discussion in the previous paragraph on potentially different sub team level shared models, I expect to see this relation to be mediated by MTS level shared knowledge.
In addition, I expect the build-up of sufficient knowledge to start on the sub team level and to be at least partly driven on the sub team level. I expect that the shared knowledge on the sub team level is brought into the MTS and will therefore be indirectly related to MTS quality – that is: a multilevel effect of sub team shared knowledge mediated by MTS level shared knowledge.

***Hypothesis 3**: Shared Knowledge on the Interface (SKIF) on the sub team level is positively related to Quality in the Multi-team system. This relationship is mediated by SKIF on the Multi-team system Level.*

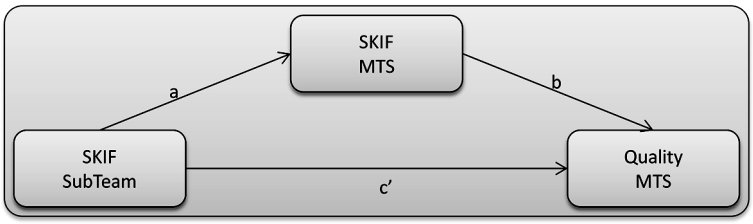

Figure 29 | Mediation Shared Knowledge on the InterFace

Similar reasoning applies to SKIS:

***Hypothesis 4**: Shared Knowledge on the Information System (SKIS) on the sub team level is positively related to Quality in the Multi-team system. This relationship is mediated by SKIS on the Multi-team system Level.*

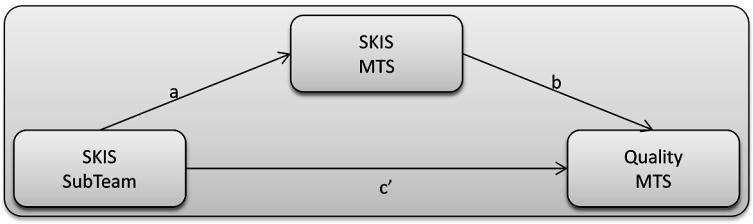

Figure 30 | Mediation Shared Knowledge on the Information System

7.4 | Method

Data collection and sample that underlie the empirical chapters are described in chapter 3, paragraphs 3.2 and 3.3.

Shared knowledge on the Information System (SKIS)

SKIS describes the (emerging) shared knowledge regarding the information system to be built. It can be viewed as an example of a shared task mental model. A 6-item, 5-point Likert scale was developed (1=not at all; 5=to a great extent) to measure SKIS. Since the focus of the SKIS variable is the team (sub team or MTS), the scale items are team-level questions ('to what degree to team members...'). In the context of OISDPs, SKIS can exist on both sub team and MTS level. Respondents were asked to answer both for their own sub team and for the MTS. In order to reduce common method bias, the reference point was shifted from sub team to MTS explicitly. The reliability of the scales as indicated by Cronbach's alpha: .811 for MTS-SKIS; .75 for sub team SKIS.

Shared knowledge on the InterFace (SKIF)

SKIF can be viewed as an example of a shared team mental model and focuses on who knows what. A 6-item, 5-point Likert scale was developed (1=not at all; 5=to a great extent) to measure SKIF. Since the focus of the SKIF variable is the team (sub team or MTS), the scale items are team level questions ('to what degree do team members...'). Similar to the discussion above on SKIS, SKIF can exist on both sub team and MTS level. Respondents were asked to answer both for their own sub team and for the MTS. In order to reduce common method bias, the reference point was shifted from sub team to MTS explicitly and the name of the sub team was an explicit part of the questions. The reliability of the scales as indicated by Cronbach's alpha: .857 for MTS SKIF; .833 for sub team SKIF.

Quality

Quality was measured by a 9 item, 5-point Likert scale (1=strongly disagree; 5=strongly agree). The 9 items focus on different aspects of IS development quality and cover topics such as specifications, issues found during testing, meeting end user requirements. The scale includes 4 reverse coded items. The reliability of the scales as indicated by Cronbach's alpha: .732.

For SKIF and SKIS, individual scores were aggregated into sub team level and MTS level scores. For quality, individual scores were aggregated to MTS level. I computed $r_{WG(J)}$scores (James, Demaree and Wolf, 1984) to check for sufficient within-group agreement. I checked for the recommended cutoff point of .70 and performed the analysis against a dataset with 35 sub teams and 80 individuals. The remaining dataset shows teams with $r_{WG(J)}$scores from .856 to 1 for SKIS in sub teams; .744 to 1 for SKIF in sub teams; .822 to 1 for SKIS in the MTS; .84 to .99 for SKIF in the MTS.
Furthermore, I used ANOVA to test between-group variance using 'project-id' as factor for the MTS-level constructs and 'subTeamIdentifier' for the sub team level constructs:
For Quality (MTS): F(20,59) = 5.04 (p=.00); SKIF (MTS): F(20,57) = 1,76 (p=.05);
SKIS (MTS): F(22,57) = 1,72 (p=.05); SKIF (sub team): F(34,45) = 1,35 (p>.05); SKIS (sub team): F(34,45) = 1,73 (p=.04). The results indicate that the between-group variance exceeds the within-group variance.

7.5 | Results

In Table 33 I report the descriptive statistics (mean, standard deviations), correlation matrix and the reliabilities for the scales.

Table 33 | Means, standard deviations and reliabilities for the scales

	Mean	SD	1	2	3	4	5
SKISa-s-s	3.66	.51	(.75)				
SKIFa-s-s	3.72	.51	.679**	(.833)			
SKISa-e-e	3.50	.42	.563**	.448**	(.811)		
SKIFa-e-e	3.49	.41	.565**	.629**	.799**	(.857)	
Quality_MTS	3.60	.48	.601**	.448**	.822**	.743**	(.732)

n=35, * p < .05. ** p< .01, Cronbach's alpha is presented in between brackets
SKISa-s-s: Shared Knowledge on the Information System on Sub team level
SKIFa-s-s: Shared Knowledge on the InterFace on Sub team level
SKISa-e-e: Shared Knowledge on the Information System on MTS level
SKIFa-e-e: Shared Knowledge on the InterFace on MTS level
Quality on the MTS level

This research focuses on Multi-team systems and looks at multilevel effects. This poses specific demands on analysis. Hypothesis H1 and H2 both reflect (only) MTS level variables whereas hypothesis H3 and H4 test multilevel hypotheses that are concerned with variables on both sub team and MTS levels. Obviously, the multilevel regression requires a dataset containing both MTS and sub team level data. On the other hand, if I were to use that same dataset to test H1 and H2, the results would be inflated as a consequence of each MTS consisting of two sub teams. I therefore tested H1 and H2 against a separate, MTS level data only, dataset.

In order to test H1 and H2, I regressed both SKIS and SKIF on the MTS level on Quality (MTS level). This step included an OLS regression. The results are presented in Table 34.

Table 34 | Results for Hypothesis 1 & 2

	Independent var.	Dependent var. Quality (MTS level)
H1	SKIFa-e-e (Shared Knowledge InterFace MTS Level)	.733***
	F-Change	22.091***
	R^2	.538
	Adj. R^2	.513
H2	SKISa-e-e (Shared Knowledge Information System MTS level)	.792***
	F-Change	31.98***
	R^2	.627
	Adj. R^2	.608

As this table shows, both hypothesis 1 and 2 are supported.

Hypothesis 3 involves the mediation effect that SKIF on the MTS level is expected to have on the relationship between sub team level SKIF and MTS level quality. In order to determine mediation effects, various methods exist. One of the most commonly used is the Baron and Kenny (1986) method. This method – the causal steps approach – estimates the various paths in the model and performs a number of statistical checks. This was discussed in paragraph 6.5 (see Figure 27).

Applying these steps to hypothesis 3 shows that: β11 = .422 is significant (p=.007); β21=.517 is significant (p=.000); β31=.851 is significant (p=.000); β42=.845 is significant (p=.000). It also shows that abs(β41) < abs(β11) (.031 < .422) and that β41 is no longer significant. Based on this reasoning, we can conclude that hypothesis 3 is supported and that Shared Knowledge for the InterFace on the MTS level mediates the relationship between SKIF on the sub team level and quality on the MTS level.

The causal steps mechanism to check for mediation received various criticisms. Shrout and Bolger (2002) state that developments in statistical theory provide alternative methods for testing direct and indirect effects in mediation models. One particularly useful alternative approach is the bootstrap framework, which can be applied even when sample sizes are moderate or small (Efron & Tibshirani, 1993). In addition, Hayes (2009) suggests that the causal steps approach has been criticized heavily because 'it is low in power' and because 'it is not based on a quantification of the very thing it is attempting to test -the intervening effect'. Bootstrapping is a method that seems to be gaining ground in determining mediation. Hayes (2012) supplies add-on software for SPSS that

offers bootstrapping capabilities. I replicated my mediation analysis using Hayes' (2012). Detailed results for Hypothesis 3 can be found in Table 35.

These results show that with bootstrapping, using sub team level SKIF on the sub team level as the predictor, SKIF on the MTS level as mediator, and Quality at the MTS level as the dependent variable, the direct effect of sub team level SKIF on MTS level quality is marginally negative yet not significant (β=.-03, p=.83) whereas the indirect effect of sub team level SKIF on MTS quality mediated by MTS SKIF is positive and significant (β=.45, 95% CI [.19;.76]), confirming the mediation effect and hypothesis 3.

Details can be found in Table 35.

Hypothesis 4 claims a similar mediation effect as hypothesis 3 and suggests that SKIS at the MTS level is expected to affect the relationship between sub team level SKIS and MTS level quality. Here as well I tested for mediation using the causal steps approach and using Hayes (2012) bootstrapping.

Applying the causal steps to hypothesis 4 shows us that: β11=.565 is significant (p=.000); β21=.469 is significant (p=.000); β31=.928 is significant (p=.000); β42=.800 is significant (p=.000). It also shows that abs(β41) < abs(β11) (.190 < .565) and that β41 is no longer significant. Based on this reasoning, we can conclude that hypothesis 4 is supported and that SKIS on the MTS level mediates the relationship between SKIS on the sub team level and quality on the MTS level. I replicated the mediation analysis using Hayes (2012). Detailed results for Hypothesis 4 can be found in Table 36.

These results show that with bootstrapping, using sub team level SKIS as the predictor, SKIS on the MTS level as mediator, and Quality at the MTS level as the dependent variable, the direct effect of sub team level SKIS on MTS level quality is marginally positive yet not significant (β=.19, p=.1) whereas the indirect effect of sub team level SKIS on MTS quality mediated by MTS SKIS is positive and significant (β=.37, 95% CI [.15;.64]).

Details can be found in table Table 36.

The results show that the direct effect that SKIS on the sub team level has on Quality MTS is non-significant (p=.0922). The bootstrap confidence interval, depicted by its lower- and upper limits (.1515 and .6448 respectively) does not contain 0 hence show a significant indirect effect of X (SKIS Sub Team) on Y (Quality MTS) through the mediator (SKIS MTS level). The Hayes' bootstrapping procedure supports Hypothesis 4.

7.6 | Discussion and managerial implications

I set out to discuss the impact of shared knowledge on Information System development teams; more specifically, on client/vendor cross organizational Multi-team systems. Previous research provided concepts and constructs that I built on in this chapter. I discussed: Uniqueness / Openness; Shared as 'in common' (shared mental models) / shared as 'distributed' (transactive memory systems); task mental model / team mental model; weak ties / strong ties. In the context of cross organizational IS development MTSs, these concepts are expected to play an important role.

The research findings in this chapter show that sharedness (both SKIS and SKIF) on the sub team level is associated with OISDP quality (MTS level) and that these relationships are mediated by sharedness on the MTS level.

Client and vendor sub teams must work together to successfully build an information system. Doing so requires shared knowledge and a common understanding of what is required (related to shared mental model and task mental model). I suggest that two types of specific shared knowledge are of relevance to the quality delivered by OISDP MTSs: task related shared knowledge (SKIS) and team related shared knowledge (SKIF). In order to build up these knowledge bases, communication and interaction are required (related to openness and strong ties). The underlying business case and driver for IS development outsourcing contracts is typically based on cost savings and access to specialized knowledge. These drivers suggest distributed expertise (specialization) and thin, artifact driven cross-team interfaces and do not motivate investing in sharedness. The importance of shared knowledge suggests that OISDP managers should not give in to the pressure to specialize too quickly.

I started out by hypothesizing that both types of shared knowledge on the MTS level would influence the overall quality of the MTS and found this to be supported by the data. The inter organizational aspect of the OISDP MTS suggests that it is not unlikely that two sub teams belonging to one MTS, develop their own shared mental models (be it SKIS of SKIF) that may be highly shared within the sub team but that may be different from that of the other sub team. If SKIS is high but different in both sub teams then SKIS on the MTS level is – by definition – low. This leads to the conclusion that sharedness per sub team is not sufficient, accuracy counts as well. This reasoning led to the multilevel aspects by suggesting that shared knowledge on the sub team level will influence overall quality but that this relationship will be mediated by shared knowledge on the MTS level. I found these mediated relationships supported both by traditional causal steps analysis and by bootstrapping.

From a managerial perspective, these findings suggest that it is of importance to invest in a solid common knowledge base; that strong shared knowledge on the task at hand must be built on the MTS level. Investing in shared knowledge in the sub teams themselves is relevant as well but care must be taken that in the end, the shared knowledge in both sub teams converges into shared

knowledge on the MTS level. This reasoning applies both to knowledge focused on the content, the task as it does to team work and process related knowledge (who knows what).

In practice, many outsourced IS development projects fail completely or are delivered too late, too expensively. One of the reasons might be the lack of sufficient investment in shared knowledge. Reality is that outsourced IS development projects are often the result of lengthy and costly formal tendering procedures. At the moment a contract is signed, both client and vendor organizations push for a thin interface in order to minimize cost and to 'get started as soon as possible'. Investing in time and effort to actually share knowledge and – at least temporarily – invest in strong ties typically is low on the priority list. It can be expected that outsourced IS development projects could and would be more successful if the necessity for investing in shared knowledge is built into contracts and tenders from the start – enabling the project (sub) teams to lay a solid foundation for their work.

In summary, The challenge for OISDP managers is to (a) overcome the natural barriers in OISD projects that tend to inhibit the buildup of shared knowledge and (b) manage the paradox that specialization is a must in OISDPs but that it must necessarily be preceded by its opposite: building shared knowledge.

Limitations and suggestions for future research

I decided to do this research in a real world environment with real projects and in a specific – but common – context: that of client/vendor MTS development teams. The research is based on a relatively small number of teams – studies that cover more teams are recommended.

I touched upon the distinction between 'shared as in common' and 'shared as distributed'. This research is based on an underlying framework that suggests that outsourced IS development projects require specialization but that, in order to successfully specialize, companies need to do the opposite first: invest in shared knowledge and team cognition. As a consequence, I expect that in different phases of the IS development project, sharedness and specialization play different roles. Investigating these temporal effects requires longitudinal research.

Thirdly, my research is based on large, relatively traditional IS development projects that use the so called waterfall development approach – still typical to most large outsourced IS development projects. I do see growing attention for Agile development methods. Such methods are inherently more focused on close client/vendor cooperation. Researching shared knowledge in large Agile development environments may provide additional insights.

7.7 | References

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7.8 | Tables & Figures

Table 35 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 3

Run MATRIX procedure:
*************** PROCESS Procedure for SPSS Beta Release 130612 ***************
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

****
Model = 4
Y = e_Qualit
X = s_Knwl_I
M = e_Knwl_I

Sample size
35

****
Outcome: e_Knwl_I

Model Summary

R	R-sq	F	df1	df2	p
,6292	,3958	21,6210	1,0000	33,0000	,0001

Model

	coeff	se	t	p
Constant	1,5648	,4172	3,7505	,0007
s_Knwl_I	,5169	,1112	4,6498	,0001

****
Outcome: e_Qualit

Model Summary

R	R-sq	F	df1	df2	p
,7439	,5533	19,8220	2,0000	32,0000	,0000

Model

	coeff	se	t	p
Constant	,6612	,4983	1,3269	,1939
e_Knwl_I	,8750	,1741	5,0264	,0000
s_Knwl_I	-,0307	,1430	-,2149	,8312

```
********************* DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE               t               p
   -,0307       ,1430         -,2149         ,8312

Indirect effect of X on Y
Effect            Boot            SE         BootLLCI     BootULCI
e_Knwl_I       ,4523         ,1430         ,1928         ,7566

********************* ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_Knwl_I = Shared Knowledge on the InterFace (sub team level)
- M = e_Knwl_I = Shared Knowledge on the InterFace (MTS level)

- The coefficients (.6612, .8750, -.0307) match the coefficients that I found using the Baron and Kenny causal steps approach.
- The direct effect (p=.8312) is non-significant.
- The bootstrap interval, depicted by its lower- and upper limits (.1928 and .7566 respectively) does not contain 0 hence show a significant indirect effect of X (SKIF Sub Team) on Y (Quality MTS) through the mediator (SKIF MTS level).

The Hayes bootstrapping procedure supports Hypothesis 3.

Table 36 | Hayes(2012) bootstrapping module in SPSS as used for testing Hypothesis 4

Run MATRIX procedure:
**************** PROCESS Procedure for SPSS Beta Release 130612 ****************
Written by Andrew F. Hayes, Ph.D. http://www.afhayes.com

```
**************************************************************************
Model = 4
Y = e_Qualit
X = s_Knwl_I
M = e_Knwl_I

Sample size
35

**************************************************************************
Outcome: e_Knwl_I

Model Summary
      R         R-sq          F          df1         df2          p
   ,5630       ,3170      15,3148      1,0000     33,0000      ,0004

Model
              coeff         se          t          p
Constant    1,7850       ,4423      4,0354      ,0003
s_Knwl_I     ,4687       ,1198      3,9134      ,0004

**************************************************************************
Outcome: e_Qualit

Model Summary
      R         R-sq          F          df1         df2          p
   ,8385     ,7031 37       ,8890      2,0000     32,0000      ,0000

Model
              coeff         se          t          p
Constant     ,1030       ,4090       ,2518      ,8028
e_Knwl_I     ,7998       ,1317      6,0727      ,0000
s_Knwl_I     ,1903       ,1096      1,7357      ,0922
```

```
********************* DIRECT AND INDIRECT EFFECTS *************************

Direct effect of X on Y
   Effect         SE          t           p
   ,1903       ,1096       1,7357      ,0922

Indirect effect of X on Y
Effect          Boot          SE        BootLLCI     BootULCI
e_Knwl_I     ,3749        ,1239        ,1515        ,6448

********************* ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
5000

Level of confidence for all confidence intervals in output:
 95,00

------ END MATRIX -----
```

Note: variable names are abbreviated by Hayes. Full names:

- Y = e_Qualit = Quality on MTS level
- X = s_Knwl_I = Shared Knowledge on the Information System (sub team level)
- M = e_Knwl_I = Shared Knowledge on the Information System (MTS level)

- The coefficients (.1030, .7998, .1903) match the coefficients that I found using the Baron & Kenny causal steps approach.
- The direct effect (p=.0922) is non-significant.
- The bootstrap interval, depicted by its lower- and upper limits (.1515 and .6448 respectively) does not contain 0 hence show a significant indirect effect of X (SKIS Sub Team) on Y (Quality MTS) through the mediator (SKIS MTS level).

The Hayes bootstrapping procedure supports Hypothesis 4.

CHAPTER 8

Concluding Chapter

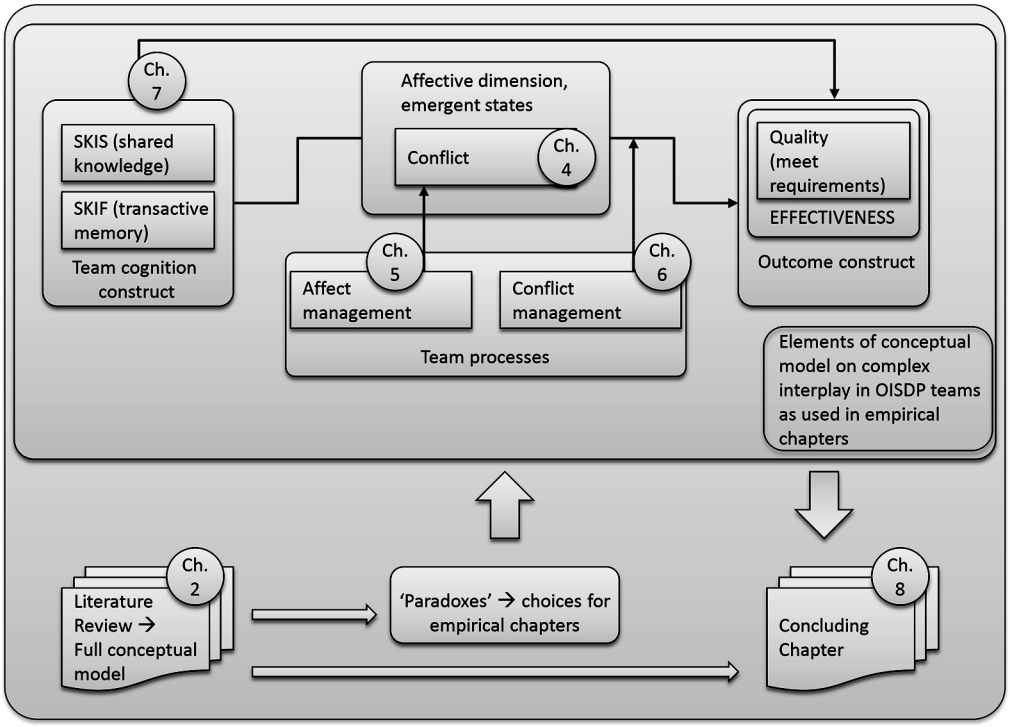

Figure 31 | Positioning chapter 8

8.1 | Notes of Reflection

As I pointed out in the foreword: it is frustration that got me started on this research; frustration with large Information System Development Projects in which we seem to make the same mistakes over and over again. The research itself was challenging and rewarding at the same time.

And of course, I ask myself whether I would do this again and if so, knowing what I know now, would I do things differently? The answer is yes. And yes…

I definitely underestimated the time it took to gather project data. And even then, the number of projects and responses in the dataset is at the minimum of what is workable from a statistical perspective. There is unfortunately only so much you can test with a relatively small dataset. In hindsight, I would have (possible should have) taken even more time to collect data and increase the dataset.

Another important lesson is to – even further – minimize ambitions regarding scope of research. Being a management consultant/program manager in daily life, the tendency to take a broad perspective and include 'the whole world' is quite strong… Even after months of 'fighting' (in the beneficial task conflict meaning of the word) with prof. dr. Meeus and dr. Curşeu on the scope of this research, and after being naively convinced that there was 'nothing left' of all the fun stuff I wanted to do, I still ended up with a far too extensive model, questionnaire and dataset (the latter in number of variables, not in number of projects and respondents). So next time (…) I would at least consider starting from a 'small idea' rather than from an encompassing model. On the upside, the model I created in the early stages of this research based on literature research, provided a basis for the rest of the work and acted as glue and conceptual cohesion that helped me to manage the broad set of topics into a coherent story.

The data collected for this research is cross sectional, therefore does not allow testing of causal effects or the effect of interventions. Although this is not something that I would necessarily do differently, if there were a next time, I would go for longitudinal research or potentially lab simulations to further test a number of the hypotheses from my models; to further clarify some of the complex multilevel dynamics and to test the size of the effects of interventions.

This research always was grounded in real life experience – as it was meant to be from the start. And that part really worked well. Many of the insights I gained, both from literature review and from the empirical research, could be and actually were used in daily project life. Concepts, models and actual interventions found their way from this research to reality. In the last paragraph of this thesis, I have tried to bring all of these insights – based on literature review and empirical research – together into an integrated model combined with practical managerial interventions.

In the beginning of this thesis, I stated the ambition to integrate different perspectives (outsourcing, IS-development, team-research, shared knowledge, conflict) into a consistent framework. I believe that, from a theoretical perspective, I managed to achieve that ambition in creating a comprehensive model grounded in existing literature (theory and empirical). From the empirical perspective, I was overly (naively perhaps) ambitious and, as a consequence, am not fully satisfied. I would like to have done much more. Examples were discussed before and include temporal effects using performance episodes, more complex interplay models covering more parts of the conceptual model, etc. The sample size of the dataset put a limit on what could be tested. Having said that, the empirical chapters as such fit well in the conceptual model and the reported findings – largely – support the hypotheses and the model. The third perspective is the practical, managerial perspective that is partly reflected in each of the empirical chapters and which, as an integrated total, can be found in paragraph 8.5. This third perspective I am happy with. I feel confident that (a) the combination of theoretical perspectives from the different research streams, (b) the findings as reported in existing literature, (c) my own conceptual model, and (d) the findings in the empirical chapters that are supportive of the conceptual model have successfully found their way to a practical integrating story that you can find in paragraph 8.5.

I hope this thesis, the findings, and the integrative model help OISD project managers to increase their chances on success. They did help me!

8.2 | Notes on Methodology

As discussed in chapter 3, data were collected by an extensive questionnaire. The teams invited to participate were all multi-team systems composed of client and vendor sub teams working on IS development projects in The Netherlands. I identified 23 projects spread over 21 different client organizations in different industries (that is 23 pairs of client/vendor teams) with in total 94 respondents. Of these respondents, 81 were male, 10 female, 3 respondents did not report their gender; ages vary from 24 to 63 with an average age of just over 42. Client organizations were selected cross-industry (government: 11, financial: 4, telecom: 2, commercial: 4, services and health: 2).

This dataset was used for multiple research questions and empirical chapters. Kirkman and Chen (2011) suggest that there is a grey area regarding publishing multiple papers from a single dataset. Using a uniqueness analysis matrix, I analyzed the chapters and concluded that the breadth of the dataset allows the intended research approach and set of chapters. Please refer to paragraph 3.3 for more details.

The data on sub teams and MTSs were collected using the same sources: respondents were asked to provide feedback on both sub team and MTS, therefore the results are susceptible to common method bias. When respondents were asked to answer both for their own sub team and for the

MTS, the reference point was shifted from sub team to MTS explicitly and the name of the (sub) team was an explicit part of the questions. In this way I pursued to mitigate common method bias. Furthermore, for instance in the chapter on emotional regulation (chapter 5), I corrected for the common method bias in the way the regression model is built. The dependent variable aggregates the evaluation of other team members and this can in fact be considered an independent source.

In the chapter on emotion regulation (chapter 5), I conducted supplementary multilevel analysis to counter the potential effects effect of endogeneity on the OLS (members in the same group are likely to report similar levels of conflict). Previous studies with similar constraints show that the two analytical procedures yield highly similar results (e.g., Liao & Chuang, 2007; Glomb & Liao, 2003). I also found the two methods to yield highly consistent results supporting the significant effects.

The research focuses on multi-team systems and looks at multilevel effects. This poses specific demands on analysis. In various chapters, I test cross-level and single level (either sub team or MTS level) hypotheses. Using multilevel regression to test hypotheses that touch both sub team and MTS level requires a dataset containing both MTS and sub team level data. On the other hand, if that same dataset would be used to test MTS-level only hypotheses, the results would be inflated as a consequence of each MTS consisting of two sub teams. I therefore created a separate, MTS level only, dataset.

In chapter 5, I evaluated task conflict and process conflict at the individual level, representing a focal individual's perception of these types of conflict. Similarly, the individual perception of emotion regulation in the team was measured. Team relationship conflict was measured as the average perception of relationship conflict in the team excluding the focal individual (for the mediation analysis a similar strategy was used for process conflict). This analytical approach allows for assigning (different) group level scores to each individual in the sample and as a consequence test the impact of individual level variables on group level constructs. It allows us to reduce the common method variance in the analyses (Glomb & Liao, 2003).

In chapter 6 on conflict management I hypothesize a number of mediation relationships. In order to determine mediation effects, various methods exist. One of the most commonly used methods is the Baron and Kenny (1986) method. This method – the causal steps approach – estimates the various paths in the model and performs a number of statistical checks. The causal steps mechanism received various criticisms such as 'low in power' and 'it is not based on a quantification of the very thing it is attempting to test: the intervening effect' (Hayes, 2009). Alternative methods have been suggested. One is the bootstrap framework, which can be applied even when sample sizes are moderate or small (Efron & Tibshirani, 1993). In chapter 6, I calculated mediation effects using both the more traditional causal steps approach and the bootstrapping approach supplied by Hayes (2012). I found highly consistent results using both methods.

As much as possible, I used existing and valid scales for this research – translated to Dutch and in some cases adapted to the OISDP context. As an example: for conflict management I used a scale based on Montoya-Weiss et al. (2001) that was adapted to better fit the content of this research by refocusing the questions from a personal perspective to a team perspective.

For a number of research specific items and to increase the robustness of findings, I created a tailored formula to calculate levels of sharedness in teams based on relatively sparse data that resulted from respondents' free text answers. Details can be found in chapter 3.

8.3 | Notes on findings

The literature review led to an overall model on team dynamics that functioned as a guiding model for the subsequent empirical research. The breadth of the model is such that it was not feasible to empirically study all of the components and relationships. Being a practitioner, I decided to focus on elements that would likely provide not only scientific insights but would also allow for translation into practical, managerial interventions: the cognitive dimension, conflict, and conflict management.

My findings on conflict spillover and transformation in Multi-team systems support the call in previous research for a multilevel focus to better understand teams – DeChurch and Marks (2006) suggested that future research is needed that explores how systems of teams interact effectively. The findings contribute to the MTS literature as well as extend the insights on MTS dynamics by exploring the conflict spillover in MTS and by providing initial evidence that conflict experienced in the sub teams is contagious to the larger MTS.

The findings in the chapter on emotion regulation (chapter 5) contribute to the literature on intra-group conflict by testing the interplay of task, process and relationship conflict in a real world multi-team systems setting by building on previous insights showing that emotion regulation is an important contingency in conflict transformation (Curşeu, Boroş and Oerlemans, 2012).

In the chapter on conflict spillover and transformation (chapter 4), I found that the relationships between conflict types on the intra organizational sub team level are different from the relationships between conflict types on the inter-organizational MTS level. On both sub team and MTS level, I found task conflict to be predictive for relationship conflict (intra level) as expected. As expected, I also found process conflict to be predictive for relationship conflict on the sub team level but I did not expect (and did not find) such a relationship on the MTS level. The explanation that I suggest is that process conflict on the sub team level will likely be associated with personal values and responsibilities, whereas the MTS-level is much more formally and contractually governed – suggesting a weaker link between personal values, relationship conflict and process conflict.

I also found the expected conflict domain specific spillover effects; that is: intra conflict domain spillover from sub team to MTS level. More interesting was the support for the hypothesis that states that sub team level task conflict is negatively related to MTS level process conflict.

On the MTS level I found an unpredicted but significant relationship between task and process conflict that was not found on the sub team level. A relationship that may be explained by the fact that at the MTS level task and process domains are more closely intertwined because of the contractually governed formal relationship that delineates tasks and responsibilities. The findings from this chapter show that conflict in a Multi-team system environment shows complex dynamics, both within and between the levels.

In chapter 5, I investigated the role of emotion regulation in the association between individual perceptions of task- and process conflict on the one hand and group relationship conflict on the other. The results show that as emotion regulation mechanisms become more effective, the association between the individual perceptions of process conflict and group relationship conflict transforms from positive to negative.

The association between individual perceptions of task conflict and group relationship conflict behaves differently. At low and average levels of emotion regulation, the association is positive and significant whereas at high levels of emotion regulation, the association between perceptions of task conflict and group relationship conflict is positive although not statistically significant.

An additional effect I found is that the interaction effect of process conflict and emotion regulation specifies the significant effect of the cross product term between task conflict and emotion regulation: group process conflict mediates the effect of the interaction between task conflict and emotion regulation on relationship conflict. That is, the emergence of process conflict in teams explains the joint effect of task conflict and emotion regulation on relationship conflict implying that task related disagreements may push the groups to engage in debates and disagreements related to task allocation and distribution of responsibilities, which in turn generate relational tensions and conflicts. The analysis also shows that perceptions of task related disagreements lead to group process conflict especially when emotion regulation mechanisms are not effective.

The chapter on conflict management (chapter 6) shows that (a) task and process conflict impact the quality of team output and (b) that cross level mediation and moderation effects exist between task and process conflict and conflict management behaviors.

I argue that successful outsourced development of an Information System requires sufficient shared systems knowledge (labeled 'Shared Knowledge on the Information System' or SKIS). I suggested that higher levels of task conflict on the MTS level signal insufficient SKIS levels, which can be expected to be negatively associated with MTS-level quality. Empirical findings supported this hypothesis. Similarly, I argue that sufficient knowledge on roles, responsibilities, and who knows what, is a

prerequisite for success. Together this form of team knowledge is labeled 'Shared Knowledge on the InterFace' or SKIF. I hypothesized that higher levels of process conflict on the MTS level signal insufficient SKIF levels and can therefore be expected to be negatively associated with MTS-level quality. The findings supported this hypothesis as well. I conclude that high levels of either task or process conflict on the MTS level can be interpreted as signals of insufficient shared knowledge and should trigger the project manager(s) to further invest in building a common understanding, in building up higher levels of shared knowledge across the team regarding either or both the Information System itself and the roles, responsibilities and cross sub team interface.

I also find that task conflict on the sub team level is negatively related to quality in the Multi-team system and that this relationship is mediated by task conflict on the Multi-team system Level through multilevel spillover effects. I find similar results for process conflict: process conflict on the sub team level is negatively related to quality in the Multi-team system and this relationship is mediated by process conflict on the Multi-team system Level through multilevel spillover effects.

An intuitively logical consequence of these hypotheses and findings is the expectation that conflict avoidance behavior on the sub team level will be negatively related to quality on the MTS level, mediated by task respectively process conflict on the MTS level. I found support for these hypotheses.

I expected to find that the task conflict spillover from sub team to MTS would be moderated by conflict management on the MTS level. I did not find support for this expected moderation effect. I had similar expectations for the process conflict spillover. Here I did find significant results. For accommodating conflict management behavior and for collaborating conflict management behavior I find that process conflict spillover declines if conflict management behavior is stronger[10].

The chapter on shared knowledge (chapter 7) shows that two types of shared knowledge on the MTS level (content/task related and team/process related) have an impact on the quality of the MTS's output.

I started out by hypothesizing that both types of shared knowledge on the MTS level would influence the overall quality of the MTS and found this to be supported by the data. The inter- organizational aspect of an MTS suggests that it is not unlikely that two sub teams belonging to one MTS, develop their own shared mental models (be it SKIS of SKIF) that may be highly shared within the sub team but that may be different from that of the other sub team. The conclusion is that sharedness per sub team is not sufficient, accuracy of the knowledge counts as well. This reasoning required a multilevel approach because it suggests that shared knowledge on the sub team level would influence overall quality, while at the same time this relationship would be mediated by shared knowledge on the MTS level. I found these mediated relationships supported both by traditional causal steps analysis and by bootstrapping.

[10] As a result of scale reliability and r_{WG} (J) scores, I had to limit the analysis to (a) accommodating conflict management and (b) collaborating conflict management and did not test other conflict management styles on the MTS level.

I summarized the hypothesis and findings from the empirical chapters below. Please refer to the respective chapters for details. The chapters are listed with the figures.

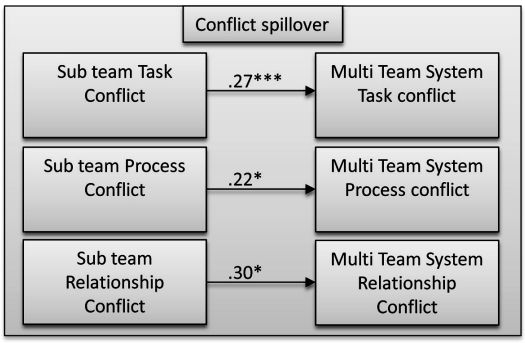

Figure 32 | Conflict Spillover (Chapter 4)

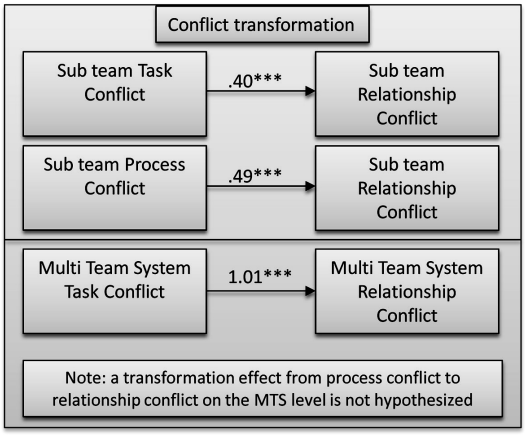

Figure 33 | Conflict transformation (chapter 4)

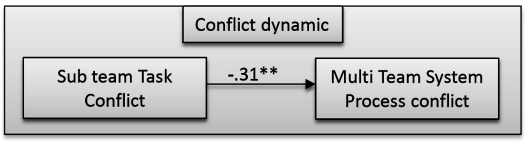

Figure 34 | Conflict Dynamic (Chapter 4)

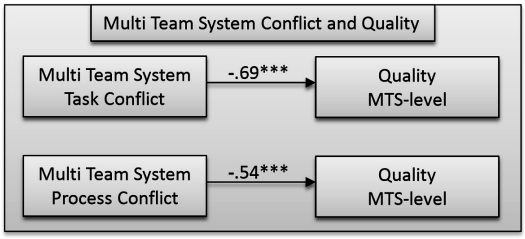

Figure 35 | Multi-team system conflict and quality (chapter 5)

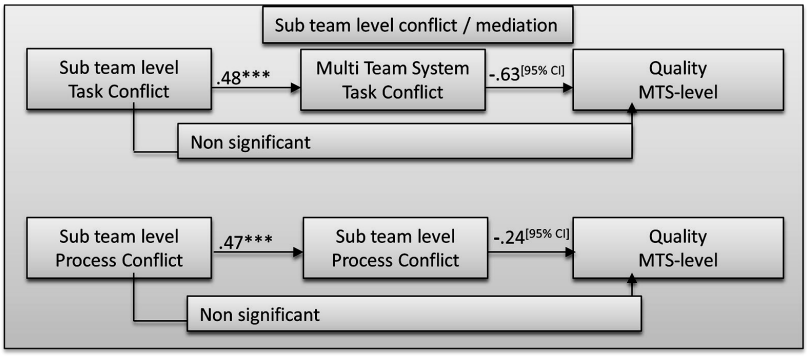

Figure 36 | Sub team level conflict/mediation (chapter 5)

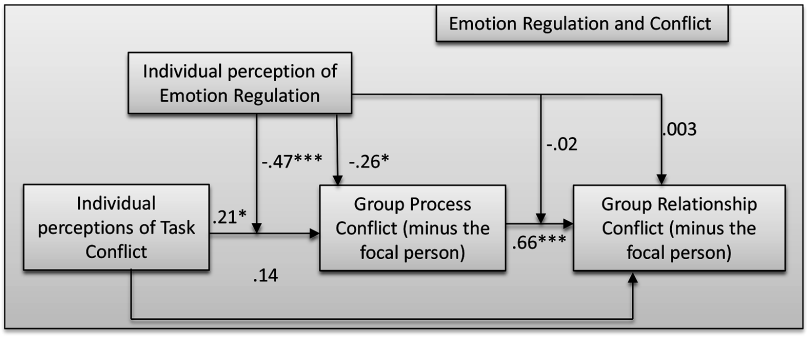

Figure 37 | Emotion regulation and conflict (chapter 5)

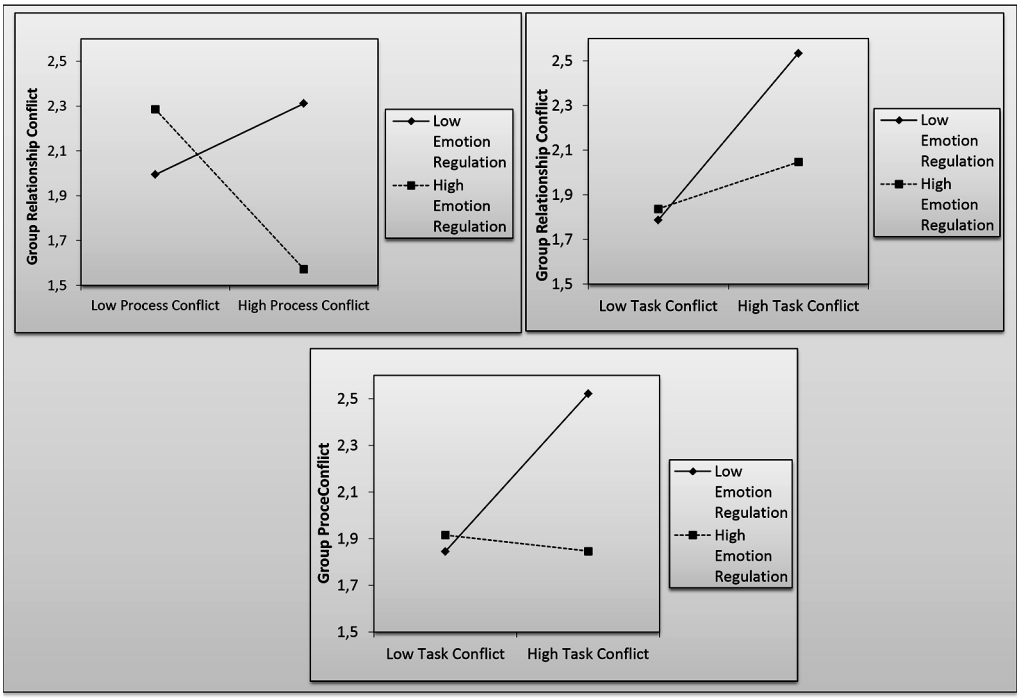

Figure 38 | Emotion regulation and conflict: slopes (chapter 5)

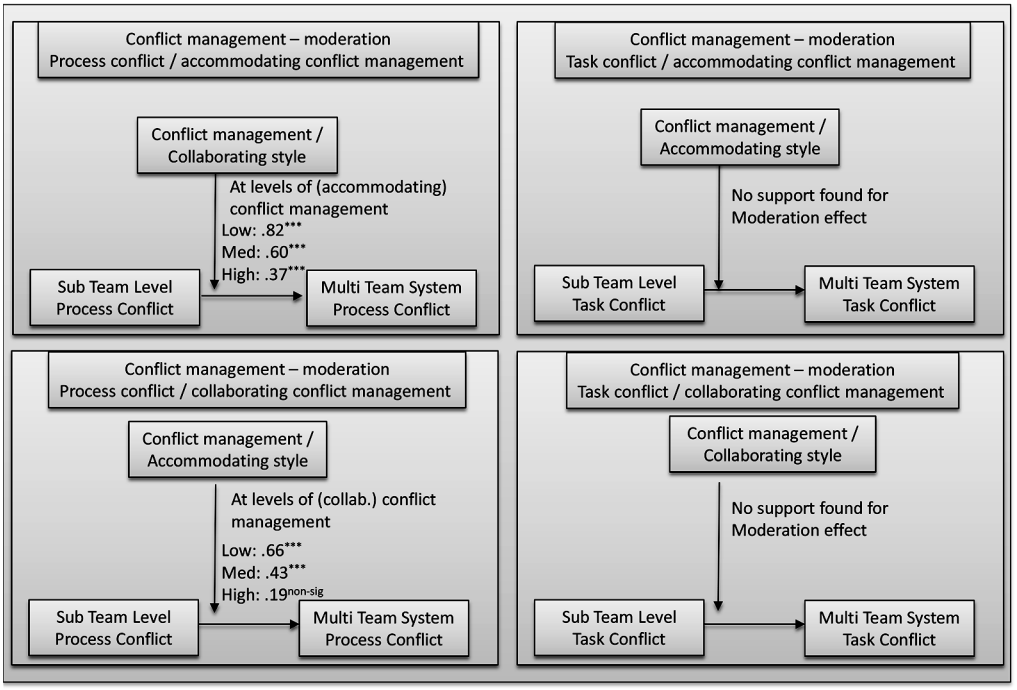

Figure 39 | Conflict management: moderating effects (chapter 6)

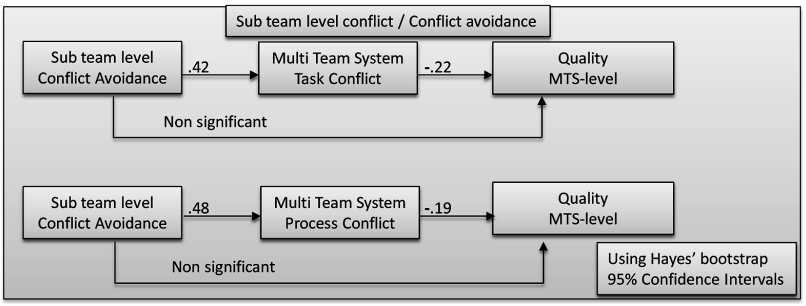

Figure 40 | Conflict Avoidance effects (chapter 6)

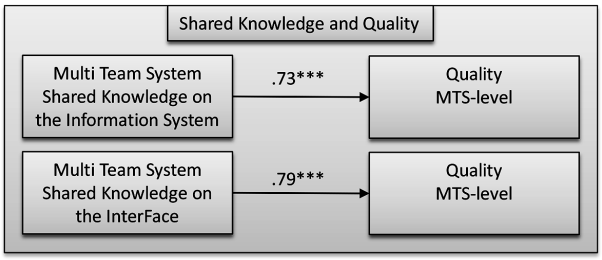

Figure 41 | Shared Knowledge and Quality (chapter 7)

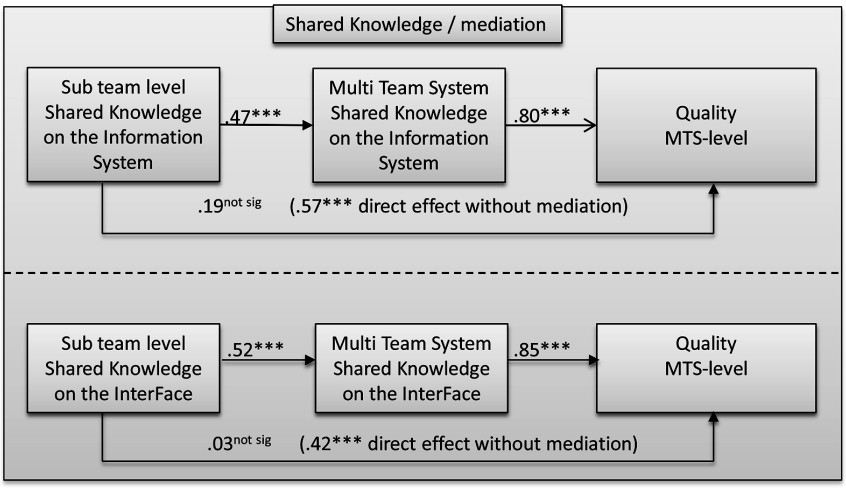

Figure 42 | Shared knowledge, mediation (chapter 7)

8.4 | Notes on future research

As a consequence of the research approach, the data is cross sectional; therefore any causal claim should be avoided. Further longitudinal or experimental research can overcome this limitation. The number of projects used in the research underlying this thesis is relatively small – additional research with a larger number of projects should strengthen the robustness of the findings as well as allow for additional research questions such as the co-occurrence of different conflict types in MTSs.

In the conflict transformation and spillover chapter (chapter4), I aggregated group and MTS level conflict scores under the homogeneity assumption (individuals in sub groups and MTS should agree on the level of conflict they experience) – future research however should relax this assumption and further explore and test (in larger samples) the effect of conflict asymmetry in MTS on MTS dynamics and performance.

In line with DeChurch and Marks (2006) I provide empirical evidence for the distinctiveness of within and between sub team dynamics in MTS. Both levels should be explored when analyzing MTS dynamics and effectiveness. Moreover, the findings show that the interaction between conflict types on the sub team level is different from the interplay on the MTS level. Therefore it is important in future research to conceptualize MTSs as multilevel dynamic entities with distinct group and inter group dynamics and to further explore the cross level interactions in conflict transformation and escalation.

I touched upon the relationship between shared knowledge and conflict in sub teams and MTSs. I suggest that task and process conflict are inevitable as means to build the required levels of shared knowledge. As a consequence, I expect that in different phases of the IS development project, conflict plays different roles. Investigating these temporal effects requires longitudinal research. Such research would offer an opportunity to follow the various transformation and spillover effects over time and would allow for measuring the effects of interventions to learn even more on how to effectively deal with and proactively use conflict to improve sub- and multi-team performance.

I discussed the distinction between 'shared as in common' and 'shared as distributed'. This research is based on an underlying framework that suggests that outsourced IS development projects require specialization but that, in order to successfully specialize, companies need to do invest in shared knowledge and team cognition first. As a consequence, I expect that in different phases of the IS development project sharedness and specialization play different roles.

Future research should disentangle the role of antecedent and response focused emotion regulation strategies on conflict escalation and transformation. The fact that the empirical research used established groups did not allow me to make such a distinction. In addition, such strategies could be explored in relation to specific emotions that result from different types of conflict and disagreements. Future research could further explore conflict transformation using a multilevel perspective in longitudinal designs.

The projects used in this research are relatively traditional IS development projects that use the so called waterfall development approach – still typical to most large outsourced IS development projects. However, the market shows growing attention for Agile development methods that are inherently more focused on close client/vendor cooperation and therefore can be expected to show different dynamics when it comes to both information sharing and conflict. Researching conflict dynamics in large Agile development environments can be expected to provide additional insights.

As a consequence of the data collection method, I could not establish independent yardsticks for accuracy of (shared) knowledge. Therefore a number of propositions that follow from the integrated model could not be tested with the data at hand. Future research could deploy a data collection method that includes a capability to establish such objective yardsticks ('what knowledge is accurate?' for instance) and use that to not only measure sharedness but also accuracy.

In this research, the focus primarily is on sharedness. The flip side of that coin is dispersion. Various mechanisms to calculate dispersion exist and future research could apply the dispersion angle to similar MTSs to test the effect of dispersion as opposed to the effects of sharedness.

One of the (fundamental) assumptions[11] underlying the integrative model is the mutual influence that the cognitive, process and affective dimensions have on each other. Due to these complex dynamics, causality may be difficult to test. Nevertheless, from a practical (effective interventions) as well as from a scientific perspective, I would suggest researchers to test the potential causal effects of increasing shared knowledge on (a) team performance (b) other elements of the dynamic model such as trust and conflict.

8.5 | Integrating summary – managerial models

In this paragraph, I will try to bridge the gap from scientific research to daily OISD-project management and to embed the scientific theory and research findings in well-known and widely used management models. I will *not* go into the details of project management methodologies such as Prince2[12] since information on these methodologies is abundantly available and methodologies such as Prince2 focus primarily (not exclusively) on the explicit coordination aspects of projects. In the course of this paragraph, I will briefly introduce a number of generally well known managerial models and then use these models as a framework to offer various perspectives on OISDP management and then 'plot' onto this framework the conclusions from (a) the literature review, (b) the findings as reported in existing literature, and (c) the results from the empirical chapters 4 through 7 in this thesis. The result is a series of practical DOs and DON'Ts.

[11] Assumption, but based on empirical findings from review of existing literature

[12] PRojects IN Controlled Environments

I will start with a song by the great singer/songwriter Billy Joel. A song that has absolutely nothing to do with IS development, with outsourcing, or with team cognition. A song however, that shows that projects are similar to real life...

8.5.1 | Running On Ice…

'Running On Ice'[13]

There's a lot of tension in this town
I know it's building up inside of me
I've got all the symptoms and the side effects
Of city life anxiety

I could never understand why the urban attitude
Is so superior
In a world of high rise ambition
Most people's motives are ulterior

Sometimes I feel as though I'm running on ice
Paying the price too long
Kind of get the feeling that I'm running on ice
Where did my life go wrong

I'm a cosmopolitan sophisticate
Of culture and intelligence
The culmination of technology
And civilized experience

But I'm carrying the weight of all the useless junk
A modern man accumulates
I'm a statistic in a system
That a civil servant dominates

And all that means is that I'm running on ice
Caught in the vise so strong
I'm slipping and sliding, cause I'm running on ice
Where did my life go wrong

[13] Lyrics from the song 'Running on Ice', Billy Joel.

As fast as I can climb
A new disaster every time I turn around
As soon as I get one fire put out
There's another building burning down

They say this highway's going my way
But I don't know where it's taking me
It's a bad waste, a sad case, a rat race
It's breaking me

I get no traction cause I'm running on ice
It's taking me twice as long
I get a bad reaction cause I'm running on ice
Where did my life go wrong

There are some striking similarities between Billy Joel's lyrics and outsourced IS development projects…

*There's a lot of tension in this **MTS***
*we know it's building up **between our teams***
we've got all the symptoms and the side effects
*Of **OISDP**[14] anxiety*

*I could never understand why our **sub teams'** attitudes*
*are so **defensive but***
In a project of high rise ambition
*Most **sub team's** motives are ulterior*

Sometimes I feel as though we're running on ice
*Paying the price too long **(…)***
Kind of get the feeling that we're running on ice
*Where did **this team** go wrong*

***We are true professional** sophisticates*
Of culture and intelligence
***A team of business** and technology*
And civilized experience

*But we're carrying the weight of **parent companies***
***Distal goals** accumulate but*
we're a statistic in a system
*That **proximal goals** dominate*

And all that means is that we're running on ice
Caught in the vise so strong
We're slipping and sliding, cause we're running on ice
*Where did **this team** go wrong*

*As fast as we **can build***
*A new **discussion** every time we turn around*
As soon as we get one fire put out
*There's another **conflict** burning us down*

[14] OISDP: Outsourced IS Development Projects

They say this highway's going our way
But we don't know where it's taking us
*It's a bad waste (**too expensive**[15]), a sad case (**low quality**), a rat race (**too late**)*
It's breaking us

We get no traction cause we're running on ice
*It's taking us twice as long **(…)***
***We get into conflicts** cause we're running on ice*
Where did this team go wrong

[15] I imagine background vocals here…

8.5.2 | Tension…

'All men are created equal.' True as this may be, it does not imply that we are all the same… Neither are all organizations and organizational objectives. Whereas this in itself is not a bad thing – life might become boring otherwise – it is something that we must deal with in outsourced IS development projects because these differences create tension both within and across teams.

Tension in itself is not necessarily a bad thing either. We use phrases like *healthy tension* for a reason… While writing this, the 2014 Winter Olympics are going on and no one will deny that the athletes experience a lot of tension before their race. Tension that seems to allow them to deliver peak performance. Then again, sometimes they do stumble and fall… (*'Nerves; the pressure of the moment; I couldn't relax; tension…')*.

But why discussing *tension* if this thesis is about shared knowledge, about conflict, emotion regulation and team performance? Because they are related – without losing ourselves in textbook definitions, one can describe *conflict* as actual confrontation whereas one can think of *tension* as the *threat* of conflict. Because tension is what project managers have to deal with on a daily basis – the tension involved in managing '*the devil's triangle*' (money, time, quality), the tension involved in managing their own teams, the tension of balancing MTS and sub team objectives. And, most importantly, because tension is an integral part from any OISD project from day one onwards as a result of the partly contradictory objectives that client and vendor have.

As said, tension is not necessarily a bad thing. Neither is conflict. As long as you manage them effectively, task- and process-conflict can actually benefit performance (other than relationship conflict that always shows detrimental performance effects). So what can you do to manage tension and conflict effectively, what can you do to make sure that they do not make us stumble and fall? Most likely you are familiar with those little evolution cartoons that show a sequence of five or six characters from monkey to caveman to modern man (or even office worker…). In OISDP projects, it sometimes seems that we reverse evolution and that we, professionals as we are, end up waving our clubs and beating each other over the head fighting over contractual issues, functional and non-functional requirements that were (or were not) part of the agreement.... Of course, fortunately, not all OISDP projects end like this but, let's face the facts: we do not have a good track record… In the introductory chapter, I mentioned the Xerox case. A 1988 case that I am sure most – if not all – contemporary project managers will recognize as today's reality. Additional facts and figures can be found in the introductory chapter (chapter 1).

The naive idea that after signing a contract, we will all live happily ever after, that we will produce better Information Systems on time against lower costs, the naive idea that is symbolized by the 'happy faces and champagne' from the introduction of this thesis is precisely that: naive. So what can you do to improve your chances of success in Outsourced Information System Development Projects? How can you leverage the findings of this research to try and improve performance? There are different perspectives to further analyze this question.

Contextual level: sources of tension

Large OISPD projects typically require a lengthy and expensive tender process. In many countries (including the Netherlands) such large projects are governed by local and international (European) legislation (European tender or, in Dutch, 'Europese aanbestedingsregels'). Typical characteristics:

- The formalized process requires a thorough and lengthy preparation from the client organization, describing requirements and decision criteria. Larger tenders easily take months to produce with associated resource utilization and costs.
- One of the key decision criteria almost inevitably is price or economic best offer.
- Answering the tender is a time- and resource consuming process for vendors. Answering a larger tender can easily cost man-months of work (with the associated cost), without any guarantee of winning the deal.
- Vendors, aware of the decision criteria, will have to come up with a financially attractive offer to be able to win. In a competitive environment with multiple professional vendors, this means that the winning vendor is often the one with the lowest price (or at least one of the cheaper vendors given the weight of price in typical decision criteria). In retrospect, the low price is frequently found to be the result of (a) opportunistic (or even unrealistic) estimates, (b) 'buying the deal': accepting low or no margins with the expectation of longer term business and hopefully profit, or (c) the worst case scenario: a vendor who bets on and will aim for the possibility of generating additionally paid work as part of the project.
- Frequently, either writing the tender (client) or producing the bids (vendors) takes longer than expected whereas the deadline or delivery date for the first deliverables typically is fixed. The result is that the period effectively available to produce results is shorter than originally planned, placing additional pressure on the multi-team project team.

The end result is that on the day the contract is signed, both client and vendor spent significant amounts of time and money and are faced with contractual obligations against a price that is likely to be (too) low and a timeline that is more often than not (too) short… Discussions about scope of the project, deliverables and additional work are almost inevitable. The tension may not be there yet, the threat for conflict most certainly is… In this thesis, I consider this situation to be a given. That is: I did not research nor will I provide suggestions or pointers on how to change or impact this phase of the OISDP. The thesis and research focus on the project phase that starts the day the contract is signed. It does so from an awareness of this context and its issues. Issues that are exacerbated in the context of OISDPs because the primary underlying reasons for outsourcing IS development are (a) expected reduced costs (b) access to specialized resources not available in house. Both of these reasons will drive client as well as vendor to strive towards a thin, contractual and artifact driven, cross-organizational interface. An understandable drive that:

a. does not support high levels of communication;
b. does not create an environment in which the sub teams are motivated to spend time learning and understanding each other's issues;
c. does not help to mitigate the inevitable tension and potential conflicts.

Sources of tension – organizational perspective

The OISDP as (temporary) organization: there are various guidelines on managing outsourced IT relationships, most of which focus on generic outsourcing and are based on success factors such as 'mutual trust', 'experience in maintaining outsourcing relationships', 'efficient and effective outsourcing contracts', 'audit and benchmarking process' (Beulen, 2004). In this research I took a different perspective that is focused more on the human side and team dynamics and that starts from the stance that projects in essence are (temporary) organizations that must align several social and economic variables within a fixed amount of time in order to be successful. As briefly touched up in paragraph 2.5.1, IS project teams can be seen as temporary organizations (Han & Hovav, 2013); that is, we can look at project organizations such as OISDPs as if they were real (albeit temporary) organizations.

This perspective is supported by looking at one of the iconic works of organizational management literature: Henry Mintzberg's "Structure in Fives" (1983). In his book, Mintzberg discusses five archetypical organizational configurations including the Adhocracy. Mintzberg offers some interesting relationships with the topics in this thesis supporting the perspective of OISDP-as-organization. First of all, the author suggests that "*sophisticated innovation requires a fifth and very different configuration, one that is able to fuse experts drawn from different disciplines into smoothly functioning ad hoc project teams*" (Mintzberg, 1984, p. 254). The author further explains that these types of 'organizations' will find it difficult to rely on "*any form of standardization for coordination*" (p. 254); a notion supporting the importance of Shared Knowledge as extensively discussed in this thesis. Even more specifically, Mintzberg (in 1983) suggests that there is a tendency towards what he calls the 'temporary adhocracy' that "*draws together specialists from different organizations to carry out a project and then disbands*". This very much describes the OISDPs discussed in this thesis. Another link from this managerial cookbook for organizational structure is the role of conflict: "*Conflict (and aggressiveness)*[16] *are necessary elements in the Adhocracy; management's job is to channel them towards productive ends*" Mintzberg, 1983, p. 277); a statement that reflects the discussion in the empirical chapters on conflict. A final interesting link can be found regarding communication: "*the root of inefficiency in the Adhocracy is high cost of communication*". This is what drives OISDPs (given the importance of cost reduction), towards an artifact driven thin interface model - as was discussed in chapter 2.

In summary, we can take the perspective of an OISDP as a real (albeit temporary) organization governed by two directors – one from each of the parent (client, vendor) organizations, and in doing so allow ourselves to use and apply the myriad of useful managerial organizational models to these OISDPs:

[16] Parenthesis added by me, not Mintzberg, since 'aggressiveness' is not an explicit aspect in this thesis.

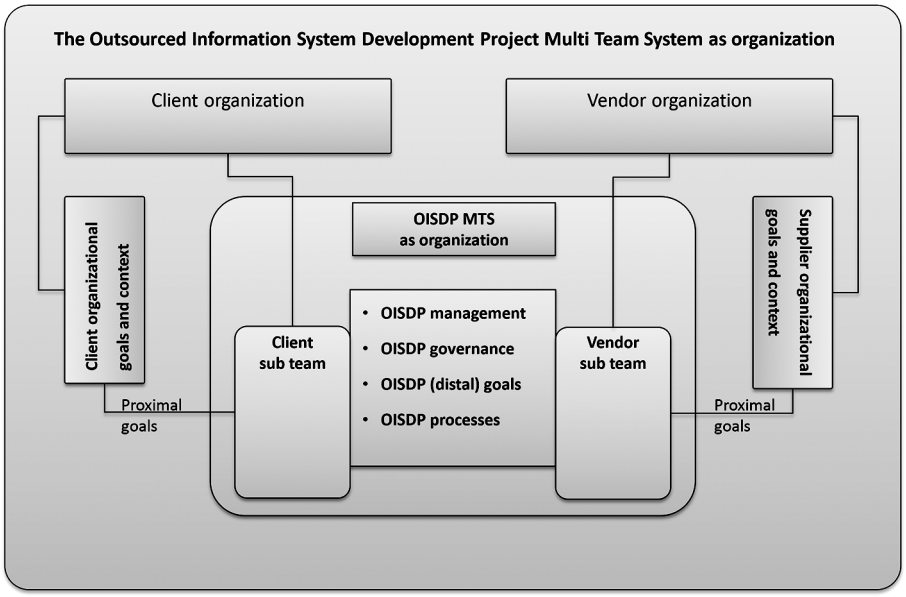

Figure 43 | Perspective of the OISDP MTS as an organization

As discussed above, Mintzberg (1983) focuses on the *structure* of organizations. However, there is more than structure... Another well-known and elegant managerial model is the so-called 7S model created by McKinsey consultants. In a 1980 article, Waterman, Peters, and Phillips suggest that the focus in organizations is often on structure and strategy. They claim and test a more extensive model that states that the relationship between "*structure, strategy, systems, style, skills, staff, and [...] superordinate goals*" is what matters. (Waterman et al., 1980, p. 17). Note: whereas their original model of these "7S's" is targeted towards organizational change, the model since then has been frequently used to analyze and balance organizations.

The 7S model recognizes the more traditional 'hard aspects' of strategy, structure, and systems and extends this with the four 'softer aspects' of *style* (the patterns of action, symbolic and actual, which top management communicates to the organization at large, and which the organization itself ultimately adopts as a cultural orientation); *staff* (meaning the people side of the organization equation), *skills* (the company's unique competences and dominating attributes); *superordinate (or shared) goals*, the set of values or aspirations which underpin what a company stands for and believe in. Watson (1983). Watson (1983) suggests that the model can be applied systematically by managers to beneficial effect, by paying attention to the soft as well as the hard S's. Please note that in modern usage, the term 'superordinate goals' is frequently changed to 'shared values' (and then overlaps with *style*).

In summary, the model suggests that the 7Ss should be aligned within an organization for that organization to be successful. Dutch former politician and minister Pieter Winsemius wrote a book on the 7S model by applying the model to the two most famous Dutch soccer teams (Ajax and Feyenoord). These two teams (from Amsterdam and Rotterdam respectively) have a long and successful history and, not unimportantly, of rivalry as do their home cities. In the Netherlands, Amsterdam and Rotterdam are the two largest cities and are the proverbial antagonists with different styles and cultures. The same is true for their soccer teams. In his book, Winsemius clearly shows that the 7S's are indeed aligned in each of the soccer teams but do fundamentally differ between the two teams. As an example, the Ajax goal keeper at that time (Stanley Menzo) used to have a very free role – he was said to be seen more on the opponent's half of the field than in his own goal – matching the (proverbial) arrogant Amsterdam hero-culture as opposed to Rotterdam's much more rule-driven 'hard working' culture and structure.

It is immediately clear that if you apply the 7S model to a multi-team system, alignment is not a given. The sub teams in an MTS come from different organizations that may or may not have similar cultures, systems, style etc. The MTS itself, if you consider it as if it were an organization, will (have to) develop its own aligned set of 7S's to be able to function effectively and efficiently. Given the different types of organizations that the sub teams come from (this is undoubtedly the case since a professional Information Systems development company is not likely to outsource its own IS-development…) it is unlikely that all (or any) of these 7S's will be a natural match. Especially the softer aspects can be expected to differ, if only because the typical IS-development company consists of predominantly technically oriented people – a characteristic that often comes with a specific set of (technical) skills, (rational and pragmatic) style, and (goal-driven) culture. As said: all men are created equal – but we are not all the same, and neither are the organizations that these proverbial men work for…

Combining the two organizational perspectives:

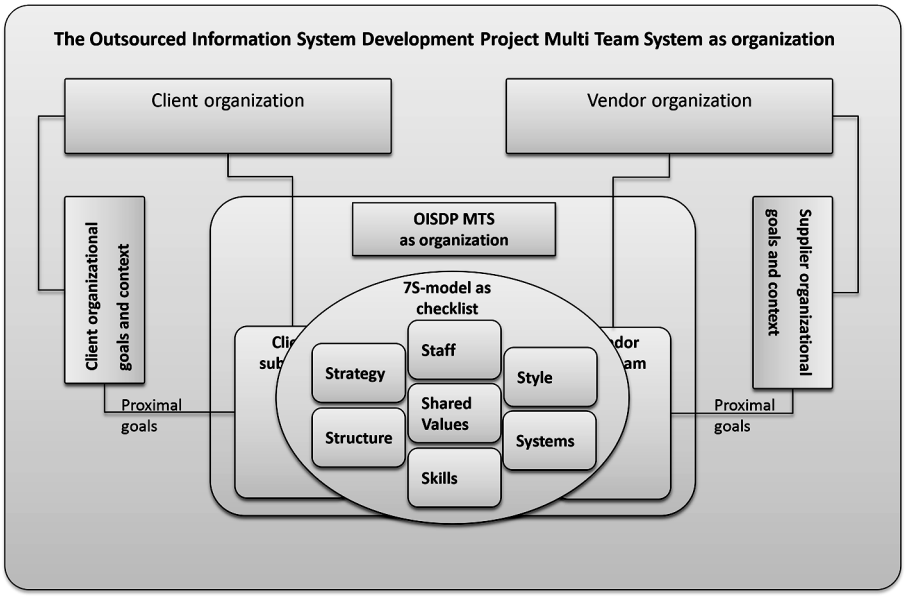

Figure 44 | The 7S model as checklist

Sources of tension: (sub) team perspective

Each sub team in an MTS is confronted with two (sets of) goals that partly overlap, partly are independent, and partly contradict. The overlapping goal is the overall MTS or OISDP goal: the distal goal of building and delivering a working and satisfactory Information System, preferably within time and budget constraints. On the other hand, each sub team is driven by the (more proximal) goals of their own parent companies. Some of these goals may overlap or may be interdependent; it is inevitable that they partly contradict. Where the client wants to spend as little money as possible and will – consciously or not – expect all and any contingency and required (explicit and implicit) functionality to be catered for by the existing contract and within the agreed upon budget, the vendor needs to make a profit and will have to keep its staff 'off the bench': any additional work (on top of the contract) means more man hours and more revenue. This inherent conflict is unavoidable in OISDPs and poses an inevitable source of tension (and often conflict) between the (managers of the) sub teams. In the introductory chapter (chapter 1) I discussed the prisoners' dilemma in the context of OISDPs. This team level prisoners' dilemma will become a source of tension and potentially conflict in OISDPs.

In addition, IS-development teams are often staffed based on either specific content skills (expertise) and/or based on availability of staff (both at client and vendor). It is rare for teams to be set up using team composition models that pay explicit attention to creating a well balanced mix of members based on team roles. Although such explicit consideration to team roles may be more important in

management teams than in expertise driven IS-development teams, neglecting these aspects is a potential cause of tension as a result of imbalance in these teams.

Sources of tension: Individual level perspective

Working in any project environment creates personal tensions. First of all, by definition of a project being a temporary structure, joining a project team can be compared to changing jobs – a well-known stress factor and tension generator… Especially with projects, there is a clear deliverable to be produced within a given timeframe. Given the reality (opportunistic planning, (too) low cost offer) that I described in the paragraph above (contextual levels), it is inevitable that these demands will lead to pressure and tension.

In addition, at the start of a project, there will be certain levels of uncertainty regarding roles and responsibilities: sources of tension for people trying to demarcate their own position in the team, in their new working environment. Finally, as projects move on and most of the original personal start up tensions may have been resolved, uncertainty about the future arises – a project has a limited lifespan: '*where will I end up when the project is finished?*' These factors are known risk factors in the sense that they are known to lead to conflict on roles and responsibilities (process conflict) and to personal irritation and relationship conflict.

Tension…

It is within this tension-laden environment that the MTS and its management have to function, have to manage the OISDP, and have to ensure effectiveness (producing high quality results) and efficiency (within budget and on time). In the research and chapters in this thesis, I focused on two fundamental dilemmas (tensions) that play on both sub team and MTS levels. Dilemmas that lead to related managerial questions.

One is related to the dilemma between shared-as-in-common (shared knowledge) versus shared-as-distributed (specialization). In short: effectiveness (high quality IS) requires a shared understanding and shared knowledge on the *content*, the critical aspects of the system to be built. I labeled this as SKIS. Similarly, efficiency (within budget, on time) requires knowledge on the process (including cross-team interface) and requires team members to know about roles and responsibilities. I labeled this SKIF. Building up SKIS and SKIF takes time and effort, which contradicts the underlying fundamental drivers of outsourcing (thin, artifact driven interfaces and specialization). How can OISDP managers efficiently deal with this dilemma?

The second element is related to conflict. Conflict that (a) is inevitable in MTS OISDPs, (b) is partly a necessity and helpful to exchange ideas and viewpoints about the system to be built (task conflict, SKIS) and about processes, procedures and responsibilities (process conflict, SKIF), and (c) was found in previous research to hurt team performance and quality. How should OISDP managers use and control conflict?

To complicate matters, conflict and the build-up of shared knowledge interact. Task and process conflict may help exchange ideas and support the increase of shared knowledge and in doing so indirectly contribute positively; on the other hand, they may distract from the content, transform into relationship conflict and have a negative impact. And vice versa: sufficient shared knowledge reduces the need for conflict and knowing about each other's processes and issues tends to increase mutual understanding and prevent conflict from arising.

8.5.3 | Integrating managerial models

One of the major, implicit, challenges that we face in large IS-development projects, is that 'we' (professionals in the IS-development field), are basically all nerds. Many of us come from a technical (computer science) background. Experience teaches that many interventions undertaken to optimize MTS performance, are of a technical nature and focus on the harder aspects of structure and systems. Examples include the initiation of additional meeting and governance structures, introducing additional monitoring systems such as more regular financial reporting etc. The softer aspects (such as style and culture) are often neglected. A possible explanation is that this is normal in the rational plan-focused IT-development world that primarily focuses on content (getting things done). Since '*we don't believe in all that soft stuff anyway…*'. This may actually be one of the toughest challenges since IS-development projects and project managers invariably have to deal with professionals; knowledge workers who have to work under high pressure inevitably leading to tension, conflict etc. An environment in which especially these softer aspects are of crucial importance. Creating the awareness that these aspects do matter, offering models and tools that encompass such aspects is a first step in a more professional and more complete set of (project) management tools.

Organizational perspective

As discussed in paragraph 8.5.2, from a managerial perspective one can look at a project organization (such as an OISDP) as if it were a real organization. Taking the organizational paradigm to look at the multi-team system allows us to leverage the extensive knowledge available from management theory and models and to apply them in the daily management of the MTS. For example the 7S-model that was discussed before, can be applied as a checklist for consistency when one considers the MTS as an organization.

In the following section(s) I will list a number of managerial suggestions and potential interventions in the form of **DO**s and **DO NOT**s based on the theory review, integrated model and findings.

DO: I advise responsible managers to (a) take an organizational perspective on the OISDP multi-team system, and (b) leverage existing management models and organizational theory to build and manage the 'MTS organization' – using the same methods, models and tools that you would if this were a fully independent organization. This includes (**DO**) installing a 2-headed (client, vendor) management team and a board-of-directors populated by senior staff from both companies. This notion follows one of the findings by Beulens and Ribbers (2002) who state that 'continuity of

personnel' in contract and account management positions in outsourced relationships is a major point of attention. By governing the relationship as if it were an organization, this issue is mitigated.

This also implies that (**DO**) the 'organization's' management must have 'organizational' (OISDP MTS) objectives. Whereas the client and vendor representative will have personal objectives related to their own parent companies, I (**DO**) advise to create a number of OISDP-related *mutually agreed upon* objectives that will be made part of the personal goals and functional evaluation of both client and vendor managers responsible for the OISDP. **DO NOT** just create non-personal goals like 'the project has to finish on time', but actually integrate mutually agreed upon goals in the personal objectives of the key players – as you would do with if this were the management team of a regular company. The purpose of this intervention is to make sure that both key players are targeted towards *common* objectives as opposed to diverging or even conflicting ones.
Note that the suggestion above – at first glance – sounds simple. It is not. Achieving goal-setting like this is a major step that involves not only adapting personal goals and objectives of individuals but, more importantly, requires both companies to discuss and agree upon **mutual** measurable and detailed objectives.

The primary objective of any organization is transforming inputs (money, other resources) into required or desired outputs. These desired outputs can be products (for example cars, pencils, computer systems, information systems) or services (such as financial services, healthcare services). This transformation process is an organization's primary process. In addition, organizations will have other (governance, supportive) processes.

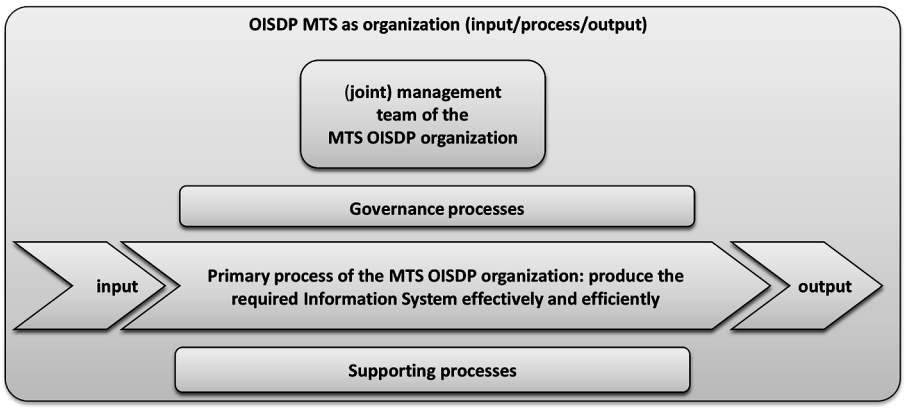

Figure 45 | IPO model of the OISDP MTS

Given these organizational perspectives on the OISDP MTS, what can be learned from this research that can help to optimally manage the complex dynamics in these multi-team systems? The initial literature review led to two initial conclusions:

– Based on Miranda and Kavan (2005), Sabherwal (1999), Kern (1997), Ring and Van De Ven (1994): the formal, written contract that is the result of the tender and bid phase is not the only contract that governs the client/vendor relationship (and therefore the MTS). A psychological contract emerges as a result of the interactions between the two companies and within the MTS.
– The second conclusion is that the dynamics within the MTS (and other teams for that matter) can be modeled using three main dimensions: processes, cognition, and emotion or, more detailed: team processes, dynamic cognitive states, emergent affective states.

The figure above, Figure 45 IPO model of the OISDP MTS, looks at an OISDP MTS as if it were an organization. Its emphasis is on the overall function of the OISDP – 'an entity that transforms inputs and resources to (hopefully) required outputs'.

Team perspective

If you shift your perspective from the organization paradigm (see above) to an internal dynamics perspective, you get the following insights into the MTS dynamics:

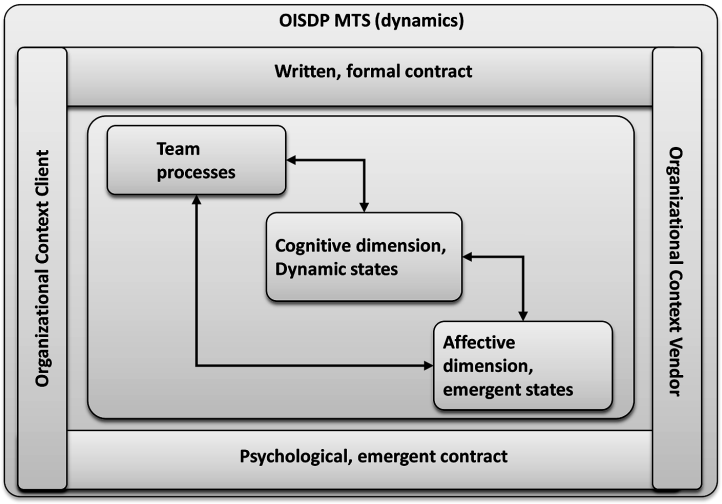

Figure 46 | OISDP dynamics –model

Often, interventions applied to optimize OISDP MTS performance are technical interventions focusing on the hard aspects – examples include: additional control mechanisms, newly introduced meeting and governance structures, more frequent financial reports. The IT industry still is primarily a hard skills focused industry; result focused more than it is people focused. Culture, interpersonal

relationships are not explicitly managed, they are treated as a given at best, a nuisance at worst. As heard before: "*Quit whining, start working – we don't have time for all that soft stuff".*
However, given the importance of the psychological contract and the relevant dimensions of team dynamics, it appears that we are underestimating and underutilizing a potentially strong intervention mechanism! The model depicted above *theoretically* provides us with three potential intervention areas:

- The team processes dimension;
- The cognitive dimension;
- The affective dimension.

Note: as mentioned before: In this thesis and research, I consider the organizational contexts (both) and the formal contract as 'given' therefore these aspects do by definition not allow for potential interventions.
Note: the quality of the psychological contract is considered to be an effect, a result of interventions (or lack thereof).

Integrated perspective

Combining Figure 45 IPO model of the OISDP MTS and Figure 46 OISDP dynamics -model, leads us the following suggestion **DO NOT:** focus on hard aspects and content only; **DO** pay explicit attention to manage the softer team-dynamics aspects by intervening on the areas mentioned above and on each process cluster level, **DO** distinguish between *MTS-as-organization* and *MTS-as-dynamic-team* and manage both explicitly on all levels using the 'intervention knobs' listed above.

Example:

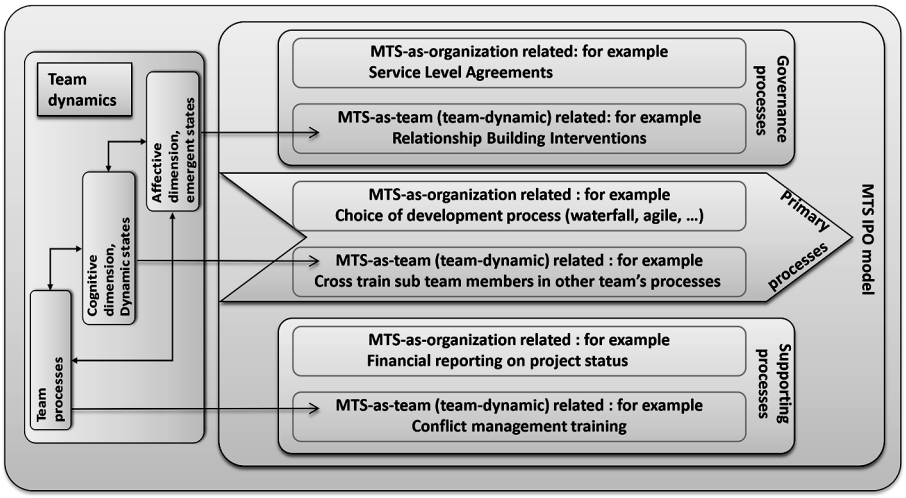

Figure 47 | Example of integrated organization and team dynamics focus

Figure 47 shows examples only[17]: interventions related to team process, cognitive, and affective dimensions can and should be applied to each of the process areas (i.e. governance, primary and supporting processes). A word of caution to the reader: when I talk about team processes I refer to intra-team dynamic processes such as communication or coordination processes. This is different from the organization level processes of an MTS; the latter refer to the three process clusters discussed in the IPO model of Figure 45.

I discussed defining *mutually agreed upon* measurable objectives as part of the personal objectives of the client and vendor managers responsible for the OISDP (the 'management team'). This suggestion followed from the MTS-as-organization perspective. From the MTS-as-team perspective, I advise to (**DO**) include team-dynamic related objectives as part of the management goals. Examples could be team member satisfaction, sick leave figures etc. Put in normal organizational terminology: include HRM-like goals.

The literature research underlying this thesis led to a comprehensive model of team dynamics; a model in which the three main clusters of *team processes, cognitive states,* and *affective states* are decomposed into separate, detailed elements.

The resulting model of team dynamics:

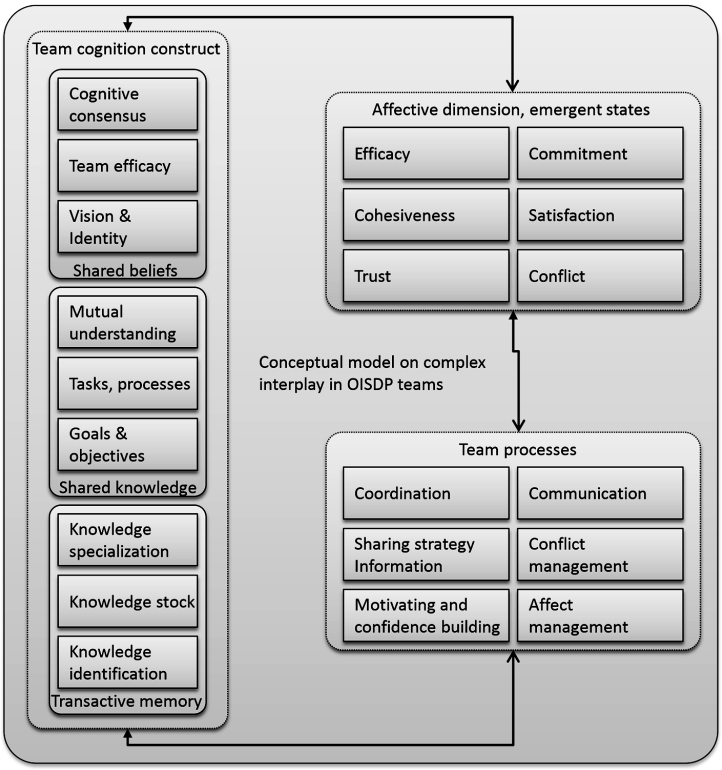

Figure 48 | OISDP dynamics – detailed model

[17] Additional interventions will be provided later in this chapter.

It would be beyond the scope of this chapter to discuss and define all of the elements in Figure 48 – they are described in Chapter2. Suffice it to say that the dynamics are complex and show mutual influences as depicted by the connecting arrows in the model.

From a managerial perspective, it is clear that the *affective dimension / emergent states* offer limited opportunity for direct intervention. Unfortunately no one has yet found a way to easily (and ethically) assure for instance *commitment, satisfaction* or *trust*. You cannot tell your team members that starting today, they have to be committed and trust each other. The components in the *affective dimension* box provide limited possibilities for *direct* interventions – they are the components that form the *psychological contract* and will be influenced indirectly.

The other two areas (process and cognition related) offer more opportunities for direct interventions: you can, for example, define processes, establish communication patterns and coordination mechanisms, and you can consciously work on conflict management competencies in order to actually use some forms of conflict to the benefit of team performance. And you can invest in a shared vision and increasing the knowledge potential (stock) in the team and invest in building shared knowledge by team sessions, education, and cross-training.

8.5.4 | Interventions

Following the reasoning in the previous paragraph, the need for more details on potential interventions arises, details on the buttons you can actually press. This paragraph provides a set of possible interventions focused on the cognitive and process dimensions in the team dynamics model. The managerial interventions suggested are based on a combination of this empirical research and on empirical findings from previous research as discussed in the literature review chapter (chapter 2).

Cognitive dimension

Note: in the following tables, I provide interventions under the headings (from the perspectives) 'MTS-as-organization' and 'MTS-as-team' respectively. These *perspectives* should not be confused with *levels*. That is: the interventions do not refer to interventions 'on MTS level' and 'on sub team level' respectively. The *perspectives* are related to the integrative model in Figure 47: the *-as-organization* perspective relates to organizational aspects (typically hard aspects such as structure, systems, or contracts) whereas the *-as-team* perspective relates to the OISDP team-dynamics aspects that are depicted in Figure 46 (summary model) and Figure 48 (detailed model).

Table 37 | Transactive Memory – interventions

Component	Description	
Transactive memory	Transactive memory is related to specialization; a detailed explanation of transactive memory and its component parts can be found in the theory chapter (paragraph 2.4).	
	Interventions	
	Perspective: MTS-as-organization	Perspective: MTS-as-team
Knowledge stock	– **DO:** OISDP management is responsible for making sure that '(project as) organization' must have all necessary skills and competences on board to be able to produce the required results. (PP) – As a consequence: **DO** guarantee sufficient access to required staff. (GP) – As a consequence: **DO** allocate budget for additional internal training of team members. (SP) Whereas these interventions sound like common sense, reality is often different: projects frequently are staffed with resources that happen to be available (primarily vendor organization) or with part time resources whose primary focus is on their regular responsibilities (primarily client organization).	– **DO:** Sub team managers should make sure that they not only pay attention to the required content skills but also the necessary process skills. That is: ensure a well-balanced team in which critical team roles are represented. (PP, GP) – Large OISD projects involve substantial amounts of financial and progress reporting. Besides the skills required for primary process tasks (like software development), **DO** also make sure that sufficient supportive experience (financial reporting etc.) is available. (SP)
Knowledge specialization	– Given the fundamental drivers of outsourcing, specialization is a must. **DO** work towards a model that supports these fundamental drivers (cost savings, specialization) by striving towards a cross sub team coordination model based on a thin client/vendor interface and allow each party to perform their own (specialized) task. (PP) – **DO NOT** however move towards this model too quickly – specialization requires its opposite (shared knowledge) first. (GP)	– Specialization does not imply ignorance about the work that others do. **DO** invest in cross training to the level that team members understand what it is that other team members (cross sub team) do. Such understanding is a prerequisite for the successful buildup of SKIF – that is, in order to develop teamwork knowledge (who does what, who knows what), task experience must be taught first. (PP)
Knowledge identification	– Knowing who (which sub team, on occasion on individual level) is responsible for what impacts both quality and timeliness. **DO** invest in a clear and unambiguous overview of (organizational) responsibilities. Which team cooperating in the OISDP is responsible for which tasks? Often the contractual obligations play an important role – they are the formal guideline but are not always known to team members. (GP)	– Knowing how, where and with whom to locate the right information and answers (task level) impacts both quality and timeliness. **DO** invest in a directory listing such information and allow people to discuss and clarify their roles and areas of expertise. This is relevant on a sub team level and on the MTS level for cross team operational and/or management contacts. (SP)
Legend in reference to Figure 45 IPO model of the OISDP MTS **PP: Primary Processes focused; GP: Governance Processes focused; SP: Supporting Processes focused**		

Table 38 | Shared Knowledge – interventions

Component	Description	
Shared knowledge	Shared knowledge is related to 'shared as in common'; a detailed explanation of Shared knowledge and its component parts can be found in the theory chapter (paragraph 2.4).	
	Interventions	
	Perspective: MTS-as-organization	Perspective: MTS-as-team
Goals & Objectives Also refer to **'SKIS'** in chapters (4 through 7)	– Goals, objectives but also risks and priorities are key elements of SKIS that guide the development effort. As was discussed at length, without sufficient SKIS, the OISD Project cannot be successful. Therefore **DO** spend sufficient time and effort to define, describe and communicate these critical components in order to build sufficient SKIS. (PP) – **DO** List and communicate non-functional objectives (for instance time-line) and consequences if these objectives are not met. (GP)	– **DO** cross validate interpretation of goals and objectives. That is: have the vendor sub teams explain their interpretation of the (distal) common goals and objectives to the client sub team and vice versa. (PP) – In addition, **DO** have the sub teams explain their own (proximal) organizational goals to the other sub team. (SP)
Task processes and interaction Also refer to **'SKIF'** in chapters (4 through 7)	– What *exactly and in detail* is expected from each of the sub teams and key roles? What are the formal interfaces between sub teams and key players? **DO** make these task- and interaction details explicit and communicate them. (PP)	– **DO** describe, communicate, and discuss the content of task related activities. For example: what is actually expected from an activity such as create functional design, or create acceptance test plan? What activity output will be acceptable as input by the other sub team? A shared model regarding the tasks, processes and interactions. (PP)
Mutual under-standing	– **DO** openly share organizational drivers and objectives. Although this introduces a certain level of vulnerability, a mutual understanding of each other's objectives supports the timely identification of potential issues and supports an atmosphere of trust and cooperation. (GP)	– **DO** set a commonly agreed upon glossary of terms and definitions. Allow team members from different sub teams (and organizations) to discuss and share the same understanding of terminology and phrases. (SP)
Legend in reference to Figure 45 IPO model of the OISDP MTS PP: Primary Processes focused; GP: Governance Processes focused; SP: Supporting Processes focused		

Table 39 | Shared Beliefs

Component	Description	
Shared Beliefs	Shared Beliefs is related to 'shared as in common'; a detailed explanation of Shared Beliefs and its component parts can be found in the theory chapter (paragraph 2.4).	
	Interventions	
	Perspective: MTS-as-organization	Perspective: MTS-as-team
Cognitive Consensus	– In the case of issues and problems (not meeting deadlines, cost overrun etc.), it is important to **DO NOT** just discuss the issue in splendid isolation but **DO** openly discuss its *impact* on the (client and/or vendor) parent organization(s). Doing so creates agreement on what the issue really is and enables constructive dialogue. (GP) – **DO** set up and communicate supporting (decision making and escalation) processes in case of objectives or goals not being met or in case of disagreements. (SP)	– **DO** create consensus on escalation procedures by defining guiding principles such as we only escalate together. That is: in case of conflict and escalation to higher hierarchical levels, this is always done through a joint memo as opposed to two separate (and likely divergent) escalation procedures. (SP) – **DO** introduce mechanisms that help guide the working relationship of key individuals such as a personal contract between the two sub team managers in which these key players – on a personal level – agree upon what they (can and may) expect from each other. (SP)
Team efficacy	– **DO NOT** limit communication to senior management in the parent companies to issues, problems and challenges. Also **DO** communicate any and all successes, milestones, products delivered etc. (SP)	– Whenever an opportunity exists, **DO** celebrate successes; the complex dynamics in teams show that a shared belief that the team can be effective, positively impacts performance. (SP) – Establish guiding principles that support team efficacy such as *'share the fame, take the blame'*; creating a team atmosphere in which people (a) are not afraid to face up to mistakes and (b) are willing to credit other team members who contributed to successes. (SP)
Vision and Identity	– For a temporary, cross organizational Multi-team system, creating a motivating vision and identity is not straightforward. The fact that sub teams will be drawn toward their own proximal objectives suggests that it *is* important to emphasize the distal, common, goals as well. **DO NOT** attempt to build a naive common vision and identity that negates the proximal goals of the client and vendor organizations; **DO** work on a shared vision for the OISDP that also enables the sub teams to reach their own separate organizational goals. (GP)	– There are different types of goals and objectives. A typical taxonomy is that of (a) '…er' goals (better, cheaper, etc.): these reflect permanent ambitions; (b) goals meant to create movement, motivation: in Dutch we label these 'magie' goals (Dutch for magic) and an acronym for meetbaar (measurable), acceptabel (acceptable), gecommuniceerd (communicated), inspirerend (inspiring), engagerend (engaging); (c) SMART goals that are action-oriented. – **DO NOT** limit goals and objectives to only task-oriented 'smart' goals, **DO** be aware that motivational aspects are of critical importance (GP, PP)

Legend in reference to Figure 45 IPO model of the OISDP MTS
PP: Primary Processes focused; GP: Governance Processes focused; SP: Supporting Processes focused

Team Cognition overall

In the research chapters in this thesis, I focused on a number of the components listed above and labeled these SKIS and SKIF respectively. SKIS, SKIF, the role they play and their importance are extensively discussed in this thesis. Both SKIS and SKIF represent *sharedness*. It is important to realize that *sharedness* alone is not enough: sub team members could have very similar models and still all be completely wrong. Although it may sound unlikely, this risk should not be ignored. There are many examples of information systems that were built but never accepted because *'this is not what we wanted'*…

Especially in performance episode-2, the ball is in the vendor's court. The focus is on developing the system and communication levels across sub teams are relatively low whereas the communication intra (vendor) sub team will be high. The risk of interpreting and creating a separate, diverging, sub team truth is real; high levels of sharedness on SKIS can be significantly reduced in this phase.

The research findings show that sharedness (both SKIS and SKIF) on the sub team level is associated with OISDP quality (MTS level) and that these relationships are mediated by sharedness on the MTS level. That is, sub team level shared knowledge works 'through' (contributing to) shared knowledge on the MTS level. It is obvious that if SKIS is high but different in both sub teams then SKIS on the MTS level is low.

The underlying business case and drivers for IS development outsourcing (cost savings, access to specialized knowledge) suggest distributed expertise (specialization) and thin, artifact driven cross-team interfaces and do not motivate investing in sharedness. I suggest that projects managers **DO NOT** succumb to the pressure to specialize too quickly and **DO NOT** communicate by artifacts only – especially in the early stages of the project. In later stages of the OISD project, (**DO**) regularly validate accuracy of sub team level knowledge with the other sub team, preventing divergence. This may be especially important in performance episode-2 (refer to paragraph 2.4.1, Figure 3 for details) in which cross sub team communication levels are relatively low.

In summary, the challenge for OISDP managers is to (a) overcome the natural barriers in OISD projects that tend to inhibit the buildup of shared knowledge and (b) manage the paradox that specialization is a must in OISDPs but that it must necessarily be preceded by its opposite: building shared knowledge.

A final suggestion regarding the cognitive dimension is to be as quick as possible in building up sharedness. This is not just an efficiency oriented suggestion but also an effectiveness one: Fichman and Levinthal (1991) from an organizational research perspective discuss organizational relationships. One of their conclusions is that organizational relationships start with a phase that they called the honeymoon period. A phase during which the risk of dissolution of a relationship is small. I suggest (**DO**) that OISDP managers use the positive momentum at the start of any project and fully leverage the honeymoon period to lay a solid and healthy foundation by investing in shared cognition (SKIS, SKIF) to prepare for the undoubtedly more stressful times that lie ahead.

Process dimension

The team dynamics model (Figure 9 Conceptualization of Dynamics in OISDP teams) shows that the three dimensions (cognitive, affective, process) are connected and will influence each other. In the previous paragraph on the cognitive dimensions, I listed a number of interventions that may support OISDP managers in *preventing* or *minimizing* conflict occurrence indirectly through building consensus, mutual understanding and shared knowledge. Examples include the personal contract, exchanging and validating objectives, cross training. In this paragraph I will focus more on *direct* interventions related to conflict. Since conflict is a double edged sword – on the one hand task and process conflict can benefit performance, on the other hand all forms of conflict can hurt team performance – I will discuss these interventions from two different angles: (a) interventions *using* conflict (task and process) to benefit team performance, and (b) interventions to *manage* conflict.

As was discussed at length in this thesis (for instance see paragraph 2.3.5), I distinguish between three types of conflict (relationship, task, and process conflict) and five types of conflict management styles (avoidance, accommodation, competition, collaboration, and compromise).

Relationship conflict

Research findings consistently show that interpersonal or relationship conflict negatively impacts team performance. Whereas this may not come as a surprise, it does suggest that (**DO**) managers should be aware that interpersonal conflicts do not only impact the people directly involved but are consistently found to be detrimental to performance. **DO** intervene by finding or imposing a resolution or potentially by replacing one or more team members.

Interventions *using* task and process conflict

Task conflict can lead to higher levels of involvement and hence better acceptance of decisions, can increase confidence, and can stimulate engagement. In addition, task conflict can bring in different opinions and viewpoints increasing overall knowledge and understanding. Following from the team dynamics model and given the necessity of shared knowledge on the information system (the task at hand), a certain level of task conflict may be a necessity to allow for exchanging viewpoints and the buildup of SKIS. Especially in performance episode-1, task conflict can play this role, allowing for sufficient shared knowledge to grow as a result of the task discussions. In performance episode-1, **DO** allow for and use task related discussions and task conflict to build and increase SKIS.

I also found that task conflict on the sub team level is negatively related to process conflict in the MTS suggesting that deliberate task-related discussions in the relatively safe environment of the sub team may not only create clarity on task content but can be expected to have other positive side effects including reduced process conflict on the MTS level. I therefore suggest that managers on the sub team level (**DO)** use task conflict to (a) create clarity on the task and (b) as a side effect use this clarity to support process related discussions on the MTS level.

Unfortunately, task conflict is not all positive.

Task conflict has also been found to negatively impact team performance by distracting from the actual work and – in situations of prolonged task conflict – by transforming into relationship conflict, which in turn has consistently been found to negatively impact performance. Findings from the empirical research support this transformation effect both on the sub team level and on the MTS level. The first managerial implication is **DO** *manage* task conflict; that is, deliberately initiate designated time slots for facilitated task discussion to prevent task conflict from distracting from actual work. The second managerial implication is **DO NOT** allow task conflicts to linger on; **DO** make sure that they are resolved in a reasonable timeframe to prevent them from transforming into detrimental relationship conflict. If necessary, intervene and end task conflicts by managerial decisions. If management on this level cannot reach a decision, then (**DO**) follow a jointly agreed upon escalation procedure (also see Table 39, cognitive consensus).

Process conflict also can benefit performance by allowing teams to reach explicit agreements about how the group will work and to clarify issues regarding roles and responsibilities. For instance Jehn (1997) found that small amounts of process conflict that were resolved efficiently facilitate performance. Similar to task conflict, a certain level of process conflict may be a necessity to allow for exchanging viewpoints and process conflict can actually benefit performance by supporting the buildup of SKIF. And again, as with task conflict and conform Jehn's findings, this is likely to be especially the case in performance episode-1. **DO** allow for and use process related discussions and process conflict to build and increase SKIF.

Here as well is the risk of process conflict transforming into relationship conflict (detrimental to performance). This risk is likely to be more prominent on the sub team level because people tend to associate role and responsibilities with personal worth and respect. On the MTS level, process and responsibility issues are mainly governed by the contractual obligations. I therefore suggest that especially sub team managers **DO** *manage* process conflict and try to abstract role, responsibility, and process discussions from personal connotations. Here as well: **DO NOT** let process conflicts linger on; **DO** intervene if necessary.

Specifically on the MTS level the results show a strong relationship between process and task conflict. The explanation is related to the one above – tasks on this level are closely related to contractual obligations and responsibilities. This strong relationship suggests that manager(s) on the MTS level should therefore not only actively balance the expected task conflict benefits against the transformation risk, they should also (**DO**) be aware of the more blurred distinction between task and process conflict in order to prevent ineffective discussions and potentially erroneous interventions.

The **DO**s and **DO NOT**s above focus on the deliberate usage of task- and process management and the effective management of conflict types. The role of task and process conflict is targeted to supporting the buildup of sufficient levels of shared knowledge (task conflict/SKIS, process conflict/SKIF) to allow the sub teams to work both effectively (primarily SKIS) and efficiently (primarily SKIF).

However, conflicts do take time and effort and therefore should only be used (or allowed) if their benefits outweigh their costs. This can be expected to be true in performance episode-1 since this is the phase in which sufficient shared knowledge must be created to allow the teams to focus on their specialized tasks and to allow the vendor to do their main task during episode-2; an episode that should be characterized by low levels of communication and focused development work. This suggests that task- and process conflict in this episode will negatively impact performance – costs outweighing benefits.

Nevertheless, task and process still have a function in episode-2 in the sense that they can be interpreted as signals of insufficient levels of shared knowledge. In these project stages high levels of task conflict are symptomatic of insufficient levels of shared task knowledge and, similarly, high levels of process conflict are symptomatic of insufficient shared process knowledge. Supporting these statements are the findings in the conflict management chapter (chapter 6); results show that both task and process conflict on the MTS level are negatively related to quality. (**DO)** be aware (create awareness) that high levels of task conflict on the MTS level may signal insufficient shared knowledge on the Information System to be built – leading to quality issues. High levels of task conflict should therefore trigger the management to further invest in building higher levels of shared knowledge on the Information System to be built across the sub teams. Similarly: (**DO)** be aware that high levels of process conflict on the MTS level may signal insufficient shared knowledge on roles, responsibilities and other process elements. This should trigger the management to invest in building a better shared understanding of such process elements. In case of high levels of task conflict within a sub team, I would advise managers to (**DO**) rebuild sufficient levels of shared knowledge and (**DO**) also reinitiate dialog with the other sub team to prevent the risk of inaccurate sub team level shared knowledge.

Interventions to manage conflict

Results of the empirical research show that all types of conflict (task, process, and relationship) show *spillover effects* from sub team to MTS. This means that sub team managers who do not deal with conflicts in their own sub team, will see their sub team conflict spill over to the MTS level, which generally will be an unwanted effect. In combination with the transformation effects described above, this emphasizes the need to **DO NOT** let conflict in the sub team level unresolved to prevent (a) potential transformation to relationship conflict and (b) to prevent spillover to the MTS level. Therefore **DO** invest in empowering sub team managers to deal with the various types of conflict for instance by training them in conflict management skills. These suggestions may sound like common sense; it is nevertheless relevant to understand that (a) conflict does not just disappear and (b) conflict does not 'stay on its own island' but tends to spread both horizontally (transform) and vertically (from sub team to MTS). Awareness of these dynamics and empowering or training managers to deal with these various conflict types is another step towards more successful multi-team projects.

Given the considerable risk on interpersonal conflict as (a) a consequence of the tension that results from the pressure that OISD projects have to deal with and (b) as a potential consequence of task and process transformation to relationship conflict, it is obvious that mechanisms would be helpful that (a) prevent, minimize, or at least control interpersonal conflict, and (b) prevent or minimize the transformation of task and process conflict into interpersonal conflict.

One of those mechanisms is *emotion regulation* (also labeled *affect management* in the team dynamic model in Figure 48). Where prolonged task and process conflict may generate relational tensions and conflicts, the empirical research shows that this happens especially when emotion regulation mechanisms are not effective. Although *all that soft stuff* is typically not priority number-1 in the typical plan and result focused OISDP environments, I strongly suggest that managers **DO NOT** ignore emotion regulation mechanisms and **DO** (a) create awareness on this topic and (b) use such mechanisms to minimize the transformation of task and process conflict into relationship conflict. In more detail: I suggest that managers **DO** make group members aware that emotion regulation strategies impact the development of relationship conflict in the group. Team members could effectively use emotion regulation as a control mechanism to prevent conflict transformation and be aware that effective emotion regulation strategies have conflict resolution potential. In particular managers may use (**DO**) normative interventions to train groups in emotion regulation. Such normative interventions can be used to help the groups develop their collective cognitive competencies and learn to block the transformation of task and process conflicts into relationship conflict. Usable mechanisms (Druskat & Wolff, 2001) focus on establishing ground rules for confronting (e.g., errant interpersonal behavior displayed by group members should be openly discussed), caring (e.g., support group members when they experience negative feelings), creating resources for working with emotions (e.g., create fun ways to relieve negative emotionality and stress) and creating an affirmative environment (e.g., focus on problem solving and not blaming) (Druskat & Wolff, 2001). Such norms may help the groups to better control and manage conflict transformation and escalation.

Above, I discussed the findings that (a) conflict on the sub team level tends to spill over to the MTS (b) conflict on the MTS level is negatively related to quality. This suggests that, in later performance episodes, conflict on the sub team level is likely to negatively impact overall quality through this spillover effect. The findings support this assumption. This suggests the need for an intervention to minimize this unwanted spillover effect. For process conflict, the findings show that cooperation oriented conflict management styles (accommodating and collaborating) on the MTS level can alleviate the conflict spillover effect. As Kellermanns et al. (2008) suggested: when strong norms of constructive confrontation are in place, teams are in a better position to reap the benefits of conflict without experiencing its negative consequences.
Given the fact that you do not want to avoid task or process conflict altogether because of their role in building up SKIS and SKIF, setting up such norms and choosing the appropriate conflict management styles is important. Whereas competitive conflict management behavior seems to be a frequently chosen style on the MTS level (supported by formal contracts), the findings show

that the higher the levels of accommodating or collaborative conflict management, the smaller the spillover effect. Therefore I suggest that managers on the MTS level **DO** use cooperative conflict management styles (accommodating and collaborating) on the MTS level.

As a logical consequence of the reasoning above and supported by the findings: On the sub team level, **DO NOT** apply the *avoiding* conflict management style since this leads to the conflict to linger on, remain unresolved and spill over to the MTS level.

The integrative model suggests that in consecutive OISDP performance episodes, the role of shared-as-in-common (shared knowledge) and shared-as-distributed (specialization) differs. In performance episodes with high levels of interdependence, both efficiency and quality are likely to benefit from increasing shared knowledge, but to suffer from specialization. In performance episodes that allow the sub teams to work independently, both efficiency and quality can be expected to benefit from specialization; however, the effect on quality is contingent on accurate shared knowledge in the MTS.

The development of shared knowledge in OISDP MTSs reflects team learning. Groups of client and vendor staff in OISDPs start a project knowing 'nothing'. They come from separate organizations with distinct contexts and are motivated by cost efficiency to limit expensive communication and interaction whereas at the same time, they are working together to achieve a common goal.

Based on the characteristics of the OISDP, team cognition elements will develop over time and across different performance episodes. For instance, in episode 1, both sharing and accuracy of the shared knowledge elements can be expected to increase since this episode inevitably involves client/vendor interaction. However, the drive towards a thin interface between vendor and client will act as a counterforce to the necessary build-up of shared knowledge. This dilemma between the need for sharing versus a thin artifact driven interface, suggests that additional conscious efforts to strengthen accurate shared knowledge in episode 1 may be required and will result in more efficiency and higher quality both in this as in later performance episodes.

In performance episode 1, there should be more emphasis on and investment in interaction and sharing knowledge to increase the sharedness and accuracy of knowledge of the information system, as well as of SKIF. Furthermore, the tendency to emphasize specialization should be controlled, since it will produce negative effects. Investing in shared knowledge should be carefully planned, not substituted for task oriented cross training (Cooke et al., 2004).

In episode 2, specialization tends to increase, supporting the underlying premise of the outsourcing endeavor. Whereas this specialization in itself can be beneficial, care has to be taken that the shared knowledge that is required to make specialization work is not lost. Because episode 2 is characterized by specialization, the sharedness of the knowledge stock will not grow. This loss of sharing is risky since it may lead to erroneous decisions.

In episode 3, due to increased interaction between the client and the vendor, an increase in accuracy and sharing of knowledge should take place. This episode relies heavily on shared knowledge.

I will finish this chapter with a small diagnostic tool, inspired by Maslow's learning phases and focusing on SKIS and Task Conflict.

Table 40 | Maslow learning phases and team cognition (SKIS)

Level of task conflict	Level of SKIS	Maslow learning phase	Typical symptoms	Notes
Low	L	Unconscious Incompetence	Performance / quality: low Atmosphere: good ('innocent bliss')	Typical for the very initial stages of an OISDP. Enthusiastic start. **DO** create awareness that a learning curve including discussions is inevitable and necessary!
High	L	Conscious Incompetence	Performance / quality: still low Atmosphere: low ('frustration')	Task Conflict is needed to develop SKIS. Task Conflict is expected to benefit performance; this is a risky phase where task conflict may transform into relationship conflict; **DO** manage morale and conflict.
High	H	Conscious Competence	Performance / quality: increasing Atmosphere: ups & downs ('conflicts but we will work it out')	Learning; in the process of building sufficient SKIS. Not there yet. **DO** manage conflict.
Low	H	Unconscious Competence	Performance / quality: high Atmosphere: good ('confidence')	Well performing team based on SKIS; **DO** validate SKIS regularly to make sure sub teams do not diverge.

A similar table can be produced for 'SKIF' and 'process conflict'.

Table 41 | Maslow learning phases and team cognition (SKIF)

Level of proc conflict	Level of SKIF	Maslow learning phase	Typical symptoms	Notes
Low	L	Unconscious Incompetence	Performance / efficiency: low Atmosphere: med/low ('tensed')	Typical for the very initial stages of an OISDP. Relative chaos: uncertainty regarding role/ responsibilities. **DO** clarify responsibilities
High	L	Conscious Incompetence	Performance / efficiency: low Atmosphere: low ('anxiety' regarding roles/ responsibilities)	Process Conflict is needed to develop SKIF. Process Conflict is expected to benefit performance; **DO** manage anxiety and conflict and clarify responsibilities and coordination patterns.
High	H	Conscious Competence	Performance / efficiency: increasing Atmosphere: low ('competitive')	Learning; in the process of building sufficient SKIFS. Not there yet. **DO** be aware of territorial battles.
Low	H	Unconscious Competence	Performance / efficiency: high Atmosphere: good ('working as a team')	Well performing team based on SKIF; **DO** reevaluate and optimize coordination patterns and interfaces regularly.

8.5.5 | Conclusions

Imagine having this conversation with a senior project manager ('SPM') from a vendor organization involved in an OISD-project:

You*:* *'You don't look too happy…'*
SPM*:* *'The project isn't going well. The client keeps coming up with these unreasonable demands that they claim are part of the contract. They don't seem to understand the issues we're facing. They're actually threatening to take us to court for not meeting contractual obligations.'*
You*:* *'Wow! What are you going to do? Are you going to the client's site now?'*
SPM*:* *'Me? No. I don't have time for that! I have to spend my time here, managing our developers.'*

This imaginary conversation is not as imaginary as it seems. It is, in fact, a (shortened) transcript of a conversation I had with a senior project manager. I have used this example often ever since. Not to highlight the discussion on 'contractual obligations or not' (which is an issue in itself), but because of the reaction of the SPM who honestly believes that he does not have time to visit the client's site and that he is doing the best thing by focusing on his own, internal organization. And this is a typical symptom of one of the main issues in these kinds of projects. Two newlyweds who, almost as soon as the honeymoon is over, go their own separate ways, focus on their own priorities, stop communicating, stop sharing, do not invest in their relationship, forget the 'for better and worse' part, and meet each other in court for a painful divorce. And it all started so well, with champagne and happy faces…

Based on the literature and empirical research described in this thesis, I strongly believe that we can and should increase the chances that client/vendor marriages will succeed. Despite the fact that – other than for real marriages fortunately – these client/vender OISDPs typically start on the wrong foot[18], I feel confident that by consciously managing the (sub- and MTS) team dynamics, we can increase your chances to live happily ever after. I provided a number of models and intervention to support OISDP management such as:

- Consider the OISDP MTS as a **real organization**, allowing you to leverage existing organizational knowledge and models.
- Manage the Multi-team system as a real organization with a **management team** that has **mutually agreed upon objectives**.
- Realize that besides the formal contract, an implicit, **psychological contract** emerges.
- Use the complementary perspective of the **MTS-as-team to add a team-dynamics** viewpoint to the organizational perspective.
- Be aware that team dynamics are a complex and dynamic interplay between three dimensions (**cognitive, affective, and process**) and focus on the dimensions that are susceptible to interventions (the cognitive and process dimensions).
- Actively **manage these team dynamics**; start with adding HRM like management objectives.
- A substantial number of **cognition related interventions** were provided.
- These interventions are focused on finding a balance between the paradox that OISDPs need **specialization** to be successful but need the opposite (**sharedness**) first.
- Cognitive dimension interventions focus on multiple aspects including **transactive memory, shared knowledge, and shared beliefs**.
- OISD projects are pressure cookers: **tension** is inevitable, as is **conflict**.
- Create awareness that **emotion regulation** (or affect management) is of relevance and coach and support team members in this area.
- Do not shy away from task and process conflict; **use task and process conflict** consciously to build shared knowledge in the appropriate project phase(s).
- In later stages, task and process conflict may **signal insufficient shared knowledge**.
- Do make sure that you manage task and process conflict to **prevent transformation** (to relationship conflict) **and spillover** (from sub team to MTS).
- Be aware of various conflict management styles and use **cooperation oriented conflict management** styles on the MTS level to alleviate conflict spillover effects.

I conclude that especially the cognitive dimension and its interventions provide managers with an almost untapped and underestimated potential to positively influence the performance of OISDP MTSs. IT-professionals know about structure, about planning, about processes, know how to set up project governance, reporting and meeting structures: *organizational processes* we all understand. Perhaps we are not as aware of *team processes* and *team dynamics*.

[18] As discussed: lengthy and expensive tender processes, focus on cost reduction and thin client/vendor interface

I hope that this thesis helps open up this black box of team internals. And that, in doing so, it creates awareness that interventions aimed at team cognition and team processes provide 'entries' into this black box. The interrelatedness of the three dimensions may make team dynamics complex, it also allows for influencing (directly or indirectly) all of these dimensions and, in doing so, team performance.

8.6 | References

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CHAPTER 9

Appendix

9.1 | Long list of potentially relevant variables from initial literature review

Research Question #1 focuses on an overall theoretical model, therefore touches up a large number of constructs and variables.

Table 42 | Long list of potentially relevant variables from initial literature review

Category	Sub category	Variables
Potentially relevant **Antecedents** from initial literature review		Age of relationship; Multilevel relationship management; Onsite presence
		Power; Predisposition; Promissory Contract
		Support from management in both companies
Potentially relevant **Outcome** variables	Efficiency	Delivery On Time; Delivery Within Budget
	Effectiveness	Technical/Quality of Deliverable; Process of software development
Potentially relevant variables from initial literature review: **team dynamics**	Process	Affect Management; Communication; Conflict Management and Resolution
		Coordination; Learning in Teams; Mission, goal and strategy Formulation
		Motivating and Confidence Building; Sharing Information; Task Programming
	Emergent, affective	Cohesiveness; Commitment; Conflict; Efficacy
	states	Personal and Social Bonds; Satisfaction; Trust
	Cognition – Task related	Transactive Memory (Knowledge Sources; Knowledge Identification)
		Task specific Knowledge (Knowledge Stock; Knowledge Specialization)
	Cognition – Team-related	Attitudes ; Cognitive Consensus; Shared Beliefs
		Shared Knowledge; Team Mental Models

9.2 | Literature: IS outcome variables

Table 43 | Literature overview of IS outcome variables

Review of the IS literature provided the following overview on relevant outcome variables. **output variables** **IS project success**	Bishop & Scott, 2000	Boehm 1981	Coopridere and Henderson, 1991	Deephouse et al., 1996	DeLone and McLean's 2003	Espinosa et al., 2002a	Espinosa et al., 2002b	Espinosa, 2001	Espinosa, DeLone, Lee, 2006	Faraj & Sproull, 2000	Goles & Chin, 2005	Guinan et al. 1998	Henderson & Lee, 1992	Henderson and Lee 1992	Hoegl, M., Weinkauf, K., Gemuenden, H. G., 2004	Hoegl, Parboteaah, Gemuenden, 2003	Jones, 1996	kang, 2006	Kotlarksy, 2005	Kotlarsky, J., Fenema P.C., Willcocks L.P., 2006	Lechler, 1997	Lee & Kim, 1999	Madhavan and Grover, 1998.	Nelson & Coopridere 1996	Nidumolu, 1996	Powers and Dickson, 1973	Ryan and O'Connor(2013)	Sargent 2006	Schrader and Goepfert, 1996	Wixom and Watson, 2001	Yang, 2008
on-time (team efficiency)		y	y	y	y	y	y	y	y	y			y	y	y	y	y	y		y	y	y	y	y	y	y	y		y	y	y
on-budget (team efficiency)		y	y	y	y			y	y	y			y	y	y	y	y	y		y	y	y	y		y	y	y		y	y	y
team member satisfaction			y	y	y				y				y					y	y						y	y				y	
system costs/effort			y	y	y				y				y					y							y	y				y	
system quality (team effectiveness)			y	y	y	y			y	y	y	y	y	y	y	y		y	y		y	y	y	y	y	y	y	y	y	y	y
system use			y	y	y				y																y	y				y	
user satisfaction			y	y	y				y																y	y				y	
meeting requirements			y	y	y	y			y	y		y	y	y				y	y			y		y	y	y				y	y
net system benefits			y	y	y				y															y	y	y				y	
team attitude/ commitment	y																	y													y
process quality								y											y	y											

9.3 | Literature: variables impacting IS development success

Literature provides an extensive list of variables reported to influence the 'success of Information Systems Development'. For readability, the table is split into two parts.

Table 44 | Variables reported to impact IS development success (part 1)

Independent variables said to influence IS development success part 1	Allen, 1977	Adler, 1995	Alavi and Leidner, 2001	Bass, 2006	Cannon-Bowers et al., 1993	Cannon-Bowers & Salas., 2001	Cooke and Szumal, 1994	Cooke et al., 2000	Cramton, 2001	Crowston and Kammerer, 1998	Cummings and Bromiley, 1996	Curtis et al., 1988	Dasgupta 1988	Earley, 1986	Espinosa et al., 2002, 2003	espinosa et al., 2002a	espinosa et al., 2002b	Espinosa, 2001	Espinosa, DeLone, Lee, 2006	Ethiraj et al., 2005	Ewers and Vessey 1981	Faraj & Sproull, 2000	Fenema (2002)	Ferratt et al., 2005	Gong et al. (2007	Gully et al., 1995	Hackman, 1987	Handy, 1995	Hauptman and Hiriji, 1996	Herbsleb and Grinter, 1999	Herbsleb et al. 2005	Hoegl, Parboteaah, Gemuenden, 2003
administrative, formal coordination																						y										
benefit/risk share																																
client-specific capabilities																				y												
cognitive synchronization				y																												
collective efficacy																																
communication	y	y								y		y			y	y			y	y									y	y		y
conflict																																
coordination (non differentiated)	y			y						y		y			y		y		y											y		

establish/maintain work norms																										y					y
expertise coordination																						y									
cohesion																									y						y
human resources capabilities																							y								
process capabilities																			y												
provide mutual support							y																								y
relationship, partnership, psych ctrct																															
shared beliefs					y			y		y									y												
shared knowledge			y						y	y						y			y		y		y		y						
shared mental model (non-differentiated)				y	y													Y													
shared mental models of task																	y													y	
shared mental models of team																	y														
task programming	y									y		y			y	y			y											y	y
transactive memory																y		y												y	
trust											y		y	y					y						y			y			

Table 45 | Variables reported to impact IS development success (part 2)

Independent variables said to influence IS development success part 2	Jarvenpaa and Ives, 1994	Jarvenpaa and Leidner, 1999	Jarvenpaa et al., 1998	Jarvenpaa, Mao, 2008	Kang et al, 2006	Katz and Allen, 1988	Kinnula, 2006	Klimoski and Mohammed, 1994	Kotlarsky et al., 2008	Kraiger et al., 1997	Kramer and Tyler, 1996	Kraut and Streeter, 1995	Lee & Kim, 1999	Levesque et al. 2001	Levina and Ross, 2003	Liang et al., 1995	Malone and Crowston, 1990, 1994	March and Simon, 1958	Mathieu et al., 2000	Mullen and Copper, 1994	Nelson & Cooprider, 1996	O'Hara-Devereaux and Johansen, 1994	Perry et al., 1994	Rajkumar and Mani, 2001	Rentsch and Hall, 1994	Robillard, 1999	Robillard, 2005	Snow et al., 1996	Teasley et al., 2002	Thompson, 1967	Tjosvold, 1984	Van de Ven et al., 1976	Wegner, 1986	Weingart, 1992	Wittenbaum and Stasser, 1996	Yang, 2008
administrative, formal coordination																																			
benefit/risk share													y																						
client-specific capabilities				y																				y											
cognitive synchronization																										y									
collective efficacy					y																														
communication				y		y						y	y	y			y	y			y		y	y					y	y		y			
conflict													y								y														
coordination (non differentiated)												y	y				y	y					y						y	y		y			
establish / maintain work norms																																	y		
expertise coordination																																			
cohesion																				y															

human resources capabilities				y											y																						
process capabilities				y											y																						
provide mutual support																															y					
relationship, partnership, psych ctrct																																				
shared beliefs								y											y					y											
shared knowledge									y			y								y														y	y
shared mental model (non-differ'd)								y		y																y									
shared mental models of task					y																															
shared mental models of team					y								y																							
task programming											y			y	y					y							y	y		y					
transactive memory																y																y			
trust	y	y	y							y		y							y					y											

9.4 | Literature: Detailed correlations between listed variables and IS development outcome

Table 46 | Correlations between Independent variables and outcome

List of variables that are found to have an effect direct and indirect) on IS-systems development success	General outcome	On budget	System quality	On time	Meet requirements
administrative, formal coordination		y		y	
benefit/risk share	y				
business understanding	y				
client-specific capabilities	y				
cognitive synchronization	y				
collective efficacy		y	y	y	y
communication	y	y		y	y
conflict (management)	y				
coordination (non differentiated)	y				
establish and maintain work norms of high effort		y	y	y	
expertise coordination		y	y	y	y
cohesion		y	y	y	
human resources capabilities	y				
process capabilities	y				
provide mutual support		y	y	y	
relationship, partnership, psychological contract	y				
shared beliefs	y		y	y	y
shared knowledge	y		y	y	y
shared mental model (non-differentiated)	y	y	y	y	y
shared mental models of task	y	y	y	y	y
shared mental models of team		y	y	y	y
task programming, organization	y	y	y	y	y
transactive memory	y		y	y	y
trust	Y				

The table shows potentially relevant direct and indirect influences based on the underlying model that is discussed in Figure 2:

Table 47 | Correlations of team cognition variables with outcome, affect and processes

Variable(s)	Reference	effect on behavioral elements/ processes	effect on affective states/ relationship	effects on IS-outcome (overall)	effects on group effectiveness in general
Variable(s)	Reference	effect on behavioral elements/ processes	effect on affective states/ relationship	effects on IS-outcome (overall)	effects on group effectiveness in general
Business understanding	Seddon et al. (2005) ; Dibbern et al.(2004)		y		
Cognitive Consensus	Goles and Chin (2005) ; Kotlarsky(2005) ; Mohammed (2001) ; Mohammed S., Ringseis, E. (2001)	y			y
Collective mind	Crowston, K., and Kammerer, E. (1998)	y		y	
Knowledge Stock	Austin (2003) ; Faraj and Sproull (2000);			y	y
Shared Understanding	Davis, A., Khazanchi, D, (2007) ; Kotlarsky, J., Fenema P.C., Willcocks L.P., (2006) ; Postrel, S. (2002); Cramton C.D. (2001) ; Nelson, K.M., Cooprider, J.G. (1996) ;	y	y	y	y
Shared Beliefs	Espinosa, J.A., Delone W., Lee G., (2006) ; Miranda, Kavan (2005); Cannon & Edmondson (2001) ; Cannon-Bowers, J.A., Salas, E., (2001)	y	y	y	y
Shared Cognition	Cannon-Bowers, J.A., Salas, E., (2001) ; Ensley and Pierce (2001)	y			y
Shared knowledge	Espinosa, J.A., Delone W., Lee G., (2006) ; Kotlarsky, J., Fenema P.C., Willcocks L.P., (2006) ; Kotlarsky(2005) ; Espinosa, A., Lerch, J., and Kraut, R. (2002a) ; Cooke, Salas, Cannon-Bowers, & Stout (2000) Faraj and Sproull (2000) ; McAllister (1995)	y	y	y	y
Shared vision	Kern(1997) ; Kern andWillcocks(2000)		y		
Social, personal bonds	Seddon et al. (2005); Kern&Willcocks(2000)		y		
Specialization	Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., Cannon-Bowers, J. (2003)				y
Team Cognition	Bushe, G.R., Coetzer, G.H., (2007) ; Cooke, N. J., Salas, E., Cannon-Bowers, J. A., & Stout, R.(2000)				y

Variable(s)	Reference	effect on behavioral elements/ processes	effect on affective states/ relationship	effects on IS-outcome (overall)	effects on group effectiveness in general
Team Knowledge, Shared Knowledge	Lander, M.C., Purvis, R.L., Mccray, G.E., Leigh, W. (2004		y		y
Team Member Schema	Rentsch & Klimoski (2001)				y
Transactive Memory	Kotlarsky, J., Fenema P.C., Willcocks L.P., (2006); Ilgen et al. (2005); Kotlarsky(2005) ; Rau, D. (2005); Brandon, D.P., Hollingshead, A.B. (2004) ; Austin (2003) ; Espinosa, A., Lerch, J., and Kraut, R. (2002a); Cannon-Bowers, J.A., Salas, E., 2001 ; Espinosa, J.A., (2001) ; Faraj and Sproull (2000) ; Liang, D. W., R. Moreland, L. Argote. (1995) ;;	y		y	y
Shared Mental Models / Team Mental Models	Yang H-D, Kang, H-R., Mason, R.M. (2008); Shanahan, C., Best, C., Finch, M., Sutton, C. (2007) ; Bass, M., (2006); Kang, H-R., Yang, H-D., Rowley, C., (2006); Lim, B., Klein, K.J., (2006); Ilgen et al. (2005) ; Mathieu J.E., Heffner, T.S., Goodwin, G.F., Cannon-Bowers, J.A., Salas E., (2005) ; Langan-Fox J., Anglim, J., Wilson, J.R. (2004) ; Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., Cannon-Bowers, J. (2003) ; Espinosa, J.A., Kraut, R.E., Lerch, J.F., Slaughter, S.A., Herbsleb, J.D., Mockus, A. (2002b); Espinosa, J.A., (2001); Marks, M.A., Mathieu, J.E., Zaccaro, S.J. (2001) ; Banks & MIllward (2000); Mathieu et al. (2000) ; Peterson, E., Mitchell, T.R., Thompson, L., Bur, R., (2000); Eby, L.T. , Meade,A.W., Parisi, A.G., Douthitt, S.S. (1999);	y	y	y	y

9.5 | Literature: variables impacting client-vendor relationship success

Literature provides an extensive list of variables reported to influence the 'success of client/vendor relationships in outsourcing'.

Table 48 | Variables reported to impact client-vendor relationship success in outsourcing

Independent variables said to influence client-vendor relationships in IT/outsourcing	Anderson & Narus 1990	Anderson & Weitz, 1989	Ang&Straub, 1998	Dibbern et al. 2004	Dietz 2004	Domberger 1998	Dwyer, Schur & Oh, 1987	Ellram & Edis 1996	Ellram 1995	Embleton & Wright 1998	Fleming & Low, 2007	Goles & Chin, 2005	Goles, 2001	Grover et al. 1996	Hart & Saunders, 1997	Heide&John, 1992	Henderson, 1990	Kanter, 1994	Kern & Willcocks, 1999	Kern & Willcocks, 2002	Kern&Willcocks, 1998	Kern&Willcocks, 2000	Kern, 1997	Kim&Chung, 2003	Kinnula 2006	Kishore et al., 2003	Klepper, 1995	Koh et al., 2004	Kotlarsky, 2005	Lacity&Hirscheim, 1993	Lee & Kim, 1999	Lee & Kim, 2005	Lee, 2001	Marcolin&McLellan, 1998	Mohr & Spekman 1994	Morgan&Hunt, 1994	Oza 2006	Ring & Van de Ven, 1994	Sabherwal1999	Sargent, 2006	Seddon et al., 2005	Spekman et al. 1999	Tuten & Urban 2001	Willcoks&Kern, 1998	Zaheer et al., 1998	Zhu et al. 2001
Age of relationship				y																										y						y								
Attitudes and Assumptions												y					y																											
Attraction				y			y					y																y																	
Benefits & risk sharing				y																										y		y												
Business understanding				y							y		y								y		y	y				y		y			y											
Commitment				y			y		y			y				y	y	y	y	y		y	y	y	y					y	y	y		y	y	y	y		y	y			y		
Communication & information sharing	y			y			y	y	y		y	y		y		y		y			y	y	y		y		y			y				y		y			y	y		y	y		
Conflict/ Conflict Resolution	y			y								y						y				y	y		y		y			y		y		y			y		y	y			y		
Consensus/Joint Expectations												y						y																		y	y		y							

Continuity expectation																							y																						
Control																		y			y																								
Cooperation	y			y								y		y						y	y		y				y										y			y	y			y		
Coordination				y							y	y																			y				y					y	y					
Cultural Similarity				y						y		y					y	y			y	y	y		y						y				y		y			y	y			y		y
Distinctive competences																																														
Emotion																			y																											
Expectations (economic) met					y		y					y													y																		y			
Fairness																									y																		y			
Flexibility/ Adaptation				y								y				y					y			y										y			y	y		y	y			y		
Honesty, openness, transparency																									y												y						y			
Influence												y															y																			
Integration/ Institutionalization											y	y					y	y	y													y			y			y		y						
Interdependence	y			y			y				y	y					y	y				y	y		y						y	y			y					y				y		
Joint Action				y								y																y			y															
Joint multilevel relationship management approach																			y	y	y	y	y		y																					y
Listening																																									y					
Long term perspective								y																	y																					
Mutual Benefits and risks			y								y						y		y									y				y														

Mutual understanding																				y																y									
Norm Development				y								y														y																				
Onsite presence																																				y									
Operation																		y																											
Participation				y							y	y																			y										y					
Perceived Performance														y											y																		y			
Personal and Social Bonds/Networks				y								y									y		y														y				y			y		
Power				y								y									y	y					y																			
Predisposition																	y																													
Quality of relationship																																									y					
Reliability																									y																		y			
Role integrity																								y																						
Satisfaction				y										y																																
Shared Knowledge											y	y					y		y		y							y	y	y		y														
Shared Vision				y								y											y																							
Solidarity																								y																						
Structure																			y																											
Support from top management in both companies								y	y		y														y						y															
Synergy between the businesses																									y																		y			
Transparency																																				y									
Trust	y	y		y	y	y	y	y			y	y		y	y		y	y			y	y	y		y	y	y				y	y	y		y	y	y	y	y	y	y	y	y	y	y	
Win-win mentality																									y										y								y			y

9.6 | Literature: team cognition variables impacting team performance

Literature provides an extensive list of team cognition variables reported to influence the (in general) team success or team performance.

Table 49 | Team Cognition variables reported to impact team performance

Literature on team cognition related variables	business understanding	cognitive consensus	collective mind	interpositional knowledge	knowledge stock	mutual knowledge	mutual understanding	schema similarity	shared beliefs	shared cognition	shared identity	shared internal frames of reference	shared knowledge	shared language	shared mental models	shared understanding	shared vision	situational awareness / situat. model	specialization	team cognition	team knowledge	team member schema	team mental models	transactive memory	trans-specialist knowledge
Arrow, H., Poole, M.S., Henry, K.B., Wheelan S., Moreland R. (2004)									y																
Austin (2003)									y															y	
Banks and Mlllward (2000)															y								y		
Bass, M., (2006)															y								y		
Brandon, D.P., Hollingshead, A.B. (2004)																								y	
Bushe, G.R., Coetzer, G.H., (2007)																				y					
Cannon and Edmondson (2001)									y																
Cannon-Bowers, J.A., Salas, E., (2001)									y	y														y	
Cannon-Bowers, Salas, and Converse (1993)															y								y		
Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995)				y																					

Carley, K.M., (1997)															y								y		
Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., Cannon-Bowers, J. (2003)															y				y				y		
Cooke, N. J., Salas, E., Cannon-Bowers, J. A., and Stout, R. (2000)																				y					
Cooke, N.J., Salas, E., Kiekel, P.A. Bell, B. (2004)															y								y		
Cooke, Salas, Cannon-Bowers, and Stout (2000)													y												
Cramton C.D. (2001)						y																			
Crowston, K., and Kammerer, E. (1998)			y																						
Curşeu, P.L. (2007)																				y					
Davis, A., Khazanchi, D, (2007)						y																			
Dibbern et al.(2004)	y					y																			
Eby, L.T. , Meade,A.W., Parisi, A.G., Douthitt, S.S. (1999)															y								y		
Ensley & Pierce (2001)										y															
Entin, E.E., Serfaty, D., Macmillan, J. (2004)																				y					
Espinosa, A., Lerch, J., and Kraut, R. (2002a)																				y				y	
Espinosa, J.A., (2001)															y								y	y	
Espinosa, J.A., Delone W., Lee G., (2006)													y											y	
Espinosa, J.A., Kraut, R.E., Lerch, J.F., Slaughter, S.A., Herbsleb, J.D., Mockus, A. (2001a)													y		y								y		
Evans W., Harper, M.E., Jentsch F., (2004)															y								y		

Faraj and Sproull (2000)					y								y		y								y	y	
Fiore, S.M., Salas, E. (2004)																				y					
Goles & Chin (2005)		y																							
Hodgkinson, G.P., Maule, A.J., Bown, N.J. (2004)															y								y		
Hollingshead, A.B. (2001)																								y	
Holmström H., Conchúir E.O., Ågerfalk, P.J., Fitzgerald B, (2006)		y																							
Ilgen et al. (2005)		y																						y	
Johnson, T.E., (2005)															y								y		
Johnson, T.E., Lee, Y., Lee, M., O'connor D.L., Khalil, M.K., Hua, X., (2007)													y	y	y						y		y		
Kang, H-R., Yang, H-D., Rowley, C., (2006)															y								y		
Kern&Willcocks(2000)															y								y		
Kern(1997)																	y								
Klimoski and Mohammed (1994)															y		y						y		
Kotlarsky(2005)													y		y								y		
Kotlarsky, J., Fenema P.C., Willcocks L.P., (2006)													y	y										y	
Lander, M.C., Purvis, R.L., Mccray, G.E., Leigh, W. (2004													y	y							y				
Langan-Fox J., Anglim, J., Wilson, J.R. (2004)															y								y		
Langan-Fox J., Wirth A., Code S., Langfield-Smith K., Wirth A. (2001)															y								y		
Langfield-Smith, K.,and Wirth, A. (1992)									y																
Lee & Kim (1999)	y																								
Levesque, Wilson, and Wholey (2001)															y								y		

Liang, D. W., R. Moreland, L. Argote. (1995)											y			y									y			
Lim, B., Klein, K.J., (2006)														y									y			
Marks, M.A., Mathieu, J.E., Zaccaro, S.J. (2001)														y									y			
Mathieu et al. (2000)														y									y			
Mathieu J.E., Heffner, T.S., Goodwin, G.F., Cannon-Bowers, J.A., Salas E., (2005)														y									y			
McAllister (1995)													y													
Miranda, Kavan (2005)									y																	
Mitchel, R., Nicholas, S. (2006)						y			y						y									y	y	
Mohammed and Dumville (2001)		y																						y	y	
Mohammed (2001)		y																								
Mohammed S., Klimoski, R., Rentsch J.R., (2000)														y									y			
Mohammed S., Ringseis, E. (2001)		y																								
Moreland and Myaskovsky (2000)																								y		
Moreland (1999)																								y		
Nelson, K.M., Cooprider, J.G. (1996)												y												y		
Nosek and Mcneese (1997)												y												y		
Peltokorpi V., (2004)																								y		
Peterson, E., Mitchell, T.R., Thompson, L., Bur, R., (2000)													y		y									y		
Postrel, S. (2002)							y									y										
Powell, A., Piccoli, G. Ives, B., (2004)		y												y								y				
Rau, D. (2005)													y	y								y		y		
Rentsch and Hall, (1994)								y																		

Rentsch and Klimoski (2001)																						y				
Rico, R., Sanchez-Manzanares, M., Gil, F., Gibson, C. (2008)													y	y							y	y				
Robillard, P.N., (1999)													y	y							y					
Rowe, A.L., Cooke, N.J. (1995)															y								y			
Rulke, D.L., Rau, D. (2000)															y								y	y		
Ryynänen, T., Jansson, K. (2007)							y									y								y		
Salas, Prince, Baker, & Shrestha, (1995)																		y								
Seddon et al. (2005)	y																	y								
Shanahan, C., Best, C., Finch, M., Sutton, C. (2007)															y								y			
Smith-Jentsch, Campbell, Milanovich, & Reynolds (2001)															y								y			
Tindale and Kameda (2000)															y								y	y		
Wegner, Erber, and Raymond (1991)																								y		
Weick and Roberts (1993)																								y		
Willcocks and Kern (1998)	y																									
Yang H-D, Kang, H-R., Mason, R.M. (2008)															y								y			